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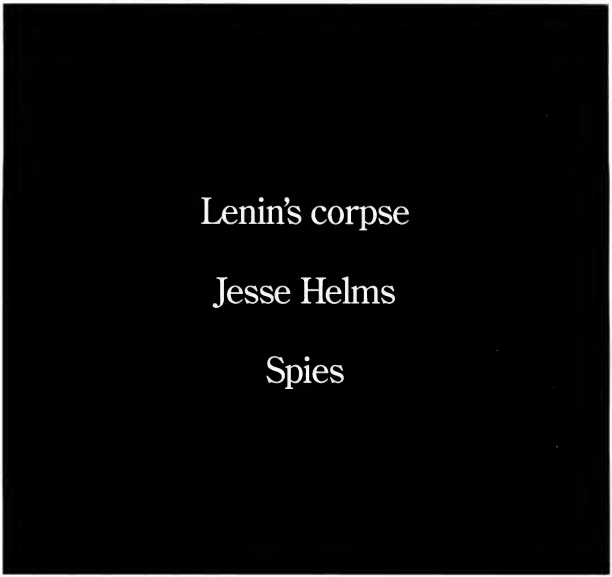

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THE BULLETIN
OF THE ATOMIC SCIENTISTS
50th Year

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THE BULLETIN
OF THE ATOMIC SCIENTISTS

The *Bulletin* was founded in 1945 by Eugene Rabinowitch and Hyman Goldsmith.
The *Bulletin* clock, symbol of the threat of global catastrophe, stands at 17 minutes to midnight.

On the cover: Cousins and best friends: Hideko and Hideyuki Tamura in Hiroshima, 1939.

Dehousing

Dozens of books and hundreds of articles have explored why atom bombs were used against Japan in August 1945. The debate has been particularly intense since 1965, with the publication of *Atomic Diplomacy* by Gar Alperovitz, who argued that the bombs were used more to intimidate the Soviets than to subdue the Japanese. It is an important debate. Official clichés and bureaucratic half-truths serve democracies poorly.

We touch upon the historical debate in this issue, but only indirectly. The bombings have been so thoroughly dissected over the years in the *Bulletin* and elsewhere that little more remains to be said. However, Arjun Makhijani, a Washington-based analyst, presents a provocative argument that Japanese forces, rather than German, may always have been the target. Meanwhile, historians Stanley Goldberg and Barton Bernstein look at the *Enola Gay*-Smithsonian fiasco, a pathetic affair that again illustrates the boundless human capacity for doing the dumb thing, even in Washington.

But it is Hideko Tamura Friedman's acute recollections of the bombing of Hiroshima that most clearly remind us what the historical debate is all about. Yes, Hiroshima was heavily militarized. War plants were scattered throughout the city and thousands of troops and tons of materiel were shipped from its harbor. But Hiroshima was also a city full of ordinary people leading everyday lives. While the work of many supported the war effort, they were civilians—and civilized nations were not supposed to target civilians.

But the British and the Americans often did just that in World War II, although few admitted it. In Europe, the British fell into a city bombing campaign early in the war, because they could seldom hit military or industrial targets with "precision." Frequently, they couldn't even find them. The British later justified systematic city raids as "attacks on enemy morale." At first, the U.S. Air Force looked down its collective nose at the Brits for "area" bombing. But when the weather turned so bad in Europe in the fall of 1944 that precision bombing was seldom possible, the Americans bombed cities, too. They called it "dehousing" workers. Upwards of 500,000 German civilians were killed by British and American dehousing raids. Perhaps as many—or more—Japanese civilians were killed by U.S. raids in the months before the A-bombs were dropped.

Killing civilians by the hundreds of thousands wasn't the original idea. Theories of strategic bombing were inspired by the Great War's cannon-fodder trench warfare, in which tens of thousands of servicemen were routinely sacrificed to gain a few shell-pocked yards. In the 1920s and 1930s, air-power visionaries spoke of using strategic bombing to end the horrors of the trenches. Locust-like fleets of long-range bombers would attack targets far behind the lines, making it impossible for the enemy to continue fighting. An influential Italian theorist said enemy civilians ought to be targeted with poison gas. The British and the Americans would have none of that. Rather, munitions plants, steel mills, rail yards, and refineries would be surgically excised, with minimum civilian casualties. Such precision bombing would end wars quickly, cleanly, humanely. The Axis powers never quite bought the idea, but the British and Americans became true believers. The first B-17 flew in 1935; the B-29 program—the Hiroshima and Nagasaki plane—got under way in January 1940, nearly two years before Pearl Harbor.

The bombing of Hiroshima and Nagasaki was a turning point in human history. Today we speak of "pre-Hiroshima" and "post-Hiroshima" worlds. The scientists who founded the *Bulletin* understood that. They knew that humankind had finally achieved a doomsday technology. And when they looked at the dozens of fire-bombed cities in Germany and Japan, they knew that that technology would be used, unless people could be persuaded to think differently. That persuasion has been the 50-year mission of the *Bulletin*.

— Mike Moore

THE BULLETIN OF THE ATOMIC SCIENTISTS

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Indefinite extension, yes

The *Bulletin*'s recent attention to the Nuclear Non-Proliferation Treaty (NPT) and its 1995 extension conference in April (November/December 1994 and January/February 1995) is to be commended. The treatment also illustrates the diversity of views that have crept into the international debate over the treaty's continuation. However, too much of the debate is focusing on scenarios for extension and straw polls and not enough on the global security interests that the NPT extension is expected to promote.

Now that the renewal conference is under way in New York, it is time for all observers—government officials and private experts alike—to step back and reflect on the broader purposes of this landmark treaty and the opportunities for further progress on nuclear arms control and disarmament that would result from its permanent renewal.

As an American and a Russian who helped to negotiate the NPT in the late 1960s, we are confident that the treaty's contribution to international security justifies its existence. Even at the height of the Cold War, our governments recognized that a world without the NPT, where the number of nuclear-weapon countries might steadily increase, would be deeply unstable. The treaty has even greater relevance in today's world, where regional and ethnic conflicts, as well as advanced weapons technologies, are spreading at alarming rates. For those who doubt the treaty's value, it should be recalled that it was the NPT norm that provided the legal basis for pursuing nuclear-weapon prevention strategies in Iraq, North Korea, and Ukraine. For all of these reasons, extending the NPT for an indefinite period is in the security interests of all nations.

Of equal if not greater importance, the NPT promotes progress on nuclear arms control. As the two states whose nuclear arsenals are many times larger than those of the other three "haves" (Britain, France, and China), this burden falls most heavily on the United States and Russia.

To be sure, both sides are progressively reducing their nuclear forces. In addition to sweeping reciprocal withdrawal of their tactical nuclear forces, under the START I treaty, which is now in force with Ukraine's accession to the NPT in December, both states are pushing their reductions in *strategic* nuclear forces as fast as possible. Under the START II treaty, which is now before the U.S. Senate and the Russian Duma, U.S. and Russian strategic nuclear forces would be brought down to levels roughly equivalent to what they were in 1970. However, domestic politics could block START II ratification in both countries and undermine prospects for a robust endorsement of the NPT's indefinite extension.

Skeptical non-nuclear NPT states fret that a permanent renewal would forever legitimize the discriminatory division of the world into "haves" and "have nots." The answer to this complaint 25 years ago was the promise by NPT signatories to negotiate an end to the arms race and move in the direction of nuclear disarmament.

As we detailed in a report for the Washington-based Lawyers Alliance for World Security, the three arms control treaties that were at the top of the 1970 agenda of "measures relating to cessation of the nuclear arms race at an early date" were: a ban on all nuclear testing, a cut-off in the production of fissionable material for use in nuclear weapons, and a promise by the nuclear signatories not to use their nuclear weapons first, or, at least not to use them against any non-nuclear weapon state that agreed to stay that way. After 25 years, none of these measures has been achieved in treaty form.

But negotiations on a comprehensive test ban (CTB) began in Geneva last year, although they have been slowed by disagreements among the five nuclear powers on whether, for example, the treaty should prohibit all nuclear explosions or only those above some threshold. To his credit, President Bill Clinton moved in the

(continued on page 68)

"Hey, Einstein! Take a look at this carburetor."

Misconceived patriotism

The Smithsonian's critics should have defended freedom rather than censorship.

By BARTON J. BERNSTEIN

In January, while trying to deny that the Smithsonian Institution had caved in to political pressure, Smithsonian Secretary I. Michael Heyman announced that the National Air and Space Museum's planned fiftieth anniversary exhibit on the role the atomic bomb played in ending World War II had been badly conceived. The exhibit, he said, should be a commemoration, not an exploration of the A-bomb controversy. Given that, a scaled-down exhibit featuring a portion of the *Enola Gay*'s fuselage, the Hiroshima plane, and a few related materials would be presented.

In short, the Smithsonian had yielded to political pressure from the Air Force Association, the American Legion, and more than 80 members of Congress, including a dozen Democrats, who accused the museum's curators of being, variously, anti-nuclear, anti-veteran, unpatriotic, and without respect for history.

Because the Smithsonian receives more than 75 percent of its funding from the federal government, and with a new Congress eager to raise corrosive questions about the use of tax money for cultural purposes, the Smithsonian found it easier to surrender than fight. Historian Stanley Goldberg, a member of the exhibit's advisory board (as was I), discusses the debacle, beginning on page 28.

The dispute raises questions about the function of museums, particularly federally funded museums. Museums were once conceived as places where artifacts were displayed without critical—and possibly unsettling—commentary. The general attitude, shared by curators, was that artifacts mostly spoke for themselves. Placards might provide some technical details, but there was no widespread understanding that such gee-whiz presentations were profoundly political. Displays that were designed to evoke wonder also suggested, by omission, a lack of historical controversy.

A generation ago, for instance, an Air and Space Museum display of a 1950s-vintage American missile would probably never have mentioned anything about the Nazi past of some its makers, or the wastefully competitive programs of rival military services, or the militarization of U.S. science and technology during World War II and the Cold War.

But that was then, and now is now. In recent years, curators at many museums, including Air and Space, have tried to broaden the intellectual scope of exhibits. The concept behind the original *Enola Gay* effort was that it presented an opportunity—and an obligation—to educate viewers about large questions.

Why were the A-bombs used? Were there viable alternatives? If so, why weren't they pursued? What were official American casualty forecasts for U.S. forces, if an invasion had been necessary? Why were Japanese civilians massively targeted? Why did some scientists dissent about the use of the bomb before Hiroshima? Was use of the bomb somehow connected to the coming Cold War?

The curators, relying on recent scholarship in designing the exhibit, provided useful evidence rather than definitive answers. But the mere asking of such questions suggested that there was not a single uncontested answer to why and how the bombs were used—and that was anathema to the Air Force Association and the Legion. For them, World War II was the "good war." Use of the atomic bombs was necessary to save American lives. End of debate.

In their appeals to patriotism and the memory of those who served in World War II, the groups claimed to speak for all veterans, and perhaps even for most Americans. If so, it was a dismaying message. Their insistence on hewing to the "official" versions of the bomb story despoiled the very democratic values that were at stake in World War II. The veterans groups tried—successfully—to block free inquiry, dialogue, questioning, and dissent.

After World War II, some of America's most respected military leaders, including Gen. Dwight D. Eisenhower, Gen. Douglas MacArthur, Adm. William Leahy, and Adm. Ernest King, questioned whether use of the A-bomb had been necessary. In their view, Japan was near collapse and surrender. Some—like Eisenhower and Leahy—went further, asking also whether the bombings had been moral.

For example, Leahy, the war-time chairman of the Joint Chiefs of Staff, wrote in 1950: "In being the first to use it [the bomb], we had adopted an ethical standard common to the barbarians of the Dark Ages. I was not taught to make war in that fashion . . . by destroying women and children."

In seeking to bar the words of Leahy, Eisenhower, King, MacArthur, and others, the Legion and the Air Force Association "patriotically" sought to rewrite history, besmirching the ideals for which so many Americans fought and died for in World War II.

If the Smithsonian's congressional critics are serious about respecting the World War II past and the sacrifices of so many Americans, they should be demanding that the Smithsonian do its duty—and at the very least restore the words of Leahy, Eisenhower, and others to the "reconstructed" exhibit. They owe that much to the American people and to the memory of those World War II military leaders. ■

Barton J. Bernstein is a historian at Stanford University and a member of the advisory board of the original Enola Gay *exhibit.*

LOS ALAMOS LABORATORY

Dust kicks up at the surface after a mid-1969 underground nuclear test at the Nevada Test Site.

How big is small?

The Nevada Test Site may not be out of business just yet. Although no nuclear test has been conducted there since September 1992 because of the U.S. testing moratorium, some Pentagon planners are said to be quietly scheming to resume nuclear tests, albeit small ones.

That's a little bizarre. After all, the United States is a key player in the Conference on Disarmament, which is attempting to hammer out a comprehensive test ban (CTB) in Geneva, an effort whose roots extend back to the Kennedy-Khrushchev era.

Because no test-ban regime could possibly police explosions of very low yields, it has been proposed—by the "declared" nuclear powers, at least—that, from a practical point of view, some small tests would be permitted even after a comprehensive test ban treaty was negotiated. Pentagon planners want to use those small tests to check weapon reliability.

But how low or high should the threshold be? Two years ago, the Pentagon suggested that a CTB should be interpreted as a ban on tests with a yield above one kiloton. That proposal, which was shot down by intense criticism in Congress and the media, is a far cry from the administration's current negotiating position in Geneva—that a CTB should ban any explosion with a fission yield in excess of four pounds.

In contrast, Russia and France want to set a threshold that would permit tests with yields of tens or hundreds of tons—in effect, to transform the treaty into a low-threshold ban. According to a knowledgeable insider, high-level Pentagon officials, including Secretary William Perry, intend to urge the administration to adopt the French position of 100 tons or more—but not just yet.

And with good reason. The Nuclear Non-Proliferation Treaty Extension Conference is now under way at the United Nations in New York. The "non-aligned" nations favor a series of five-year extensions, but the United States has pushed hard for an indefinite and unconditional extension of the treaty.

The non-aligned already say that the nuclear-weapons states have not lived up to their end of the NPT bargain, and a test-ban threshold that might permit the nuclear powers to continue refining their nuclear weapons would chill any good will that the nuclear powers have been able to cultivate.

Until now, the non-nuclear weapon states have left the nuclear powers to settle the issue of "permitted experiments." But there *are* limits: "We believe the international community as a whole will simply not accept . . . ideas we have seen reported . . . of nuclear explosions under a CTBT with tons—some mention hundreds of tons—of explosive yield," Australian Amb. Richard Starr said in February.

Tests with significant yields are too close to what the non-aligned have feared all along—that as soon as they agree to an indefinite extension, some or all of the weapon states will walk away from nuclear disarmament and backtrack on their commitment to end testing. Progress has been made in the last year on the CTB as well as on a ban on the production of fissile materials for weapons, but no binding agreements have been concluded.

If tests with yields in the tens to hundreds of tons are permitted, it would eliminate the principal security benefits a CTB would bring. First, it would not prevent the nuclear powers from developing new weapons. The United States has already built weapons in the 10-ton range, and the nuclear weapons laboratories considered building "mini-nukes"—a new breed of low-yield nuclear weapons—after the Gulf War.

Second, it would not prevent countries that have not signed the NPT from developing more advanced weapons. The so-called threshold states need to test to reduce the size and weight of their weapons—and to experiment with more powerful, "boosted" weapons. According to

Ray Kidder, a nuclear weapons expert at the Lawrence Livermore National Laboratory, "anything over 10 tons would be of very considerable use to a proliferator."

These are the same arguments that were used two years ago to defeat the Pentagon's one-kiloton proposal, but they are still relevant today. Furthermore, recent studies suggest that the United States has little to lose no matter how low the threshold.

In November 1994, the JASONs—a group of defense consultants—declared that the United States does not even need tests below the 4-pound threshold: "The very limited added value of hydronuclear [4-pound] tests that provide for a brief glimpse into the very early stages of criticality has to be weighed against costs, and against the impact of continuing an underground testing program at the Nevada Test Site on U.S. nonproliferation goals. On balance we oppose hydronuclear testing." Instead, the JASONs endorsed the Energy Department's "stockpile stewardship" program, which calls for a variety of new facilities to simulate nuclear tests.

Meanwhile, it's not altogether clear where the administration stands on the CTB. On January 30, Anthony Lake, the president's national security adviser, announced that the United States was withdrawing a controversial proposal that would have allowed any nation to withdraw from the treaty after ten years. As for permitted experiments, he said the United States expected the CTB to meet three criteria: it should be *comprehensive* and promote nonproliferation; it should not interfere with activities required to maintain the safety and reliability of the nuclear stockpile; and it should be signed by all the declared nuclear states and as many other nations as possible.

Lake said, "As the negotiations proceed, the United States will continue to review its position on this issue to insure it meets these criteria." The criteria, however, seem contradictory. Another member of the administration characterized Lake's announcement as "a crowd pleaser," with "something in it for everyone."

At this juncture, it's difficult to tell just how wide support might be in the administration for a threshold that permits large "small" tests. Although Defense Secretary Perry is said to favor it, it does not follow that the State Department, the Energy Department, the National Security Council, the Arms Control and Disarmament Agency, or President Clinton would be willing to sign off on it.

One can even hope that the folks at the Pentagon might have the good sense to drop the idea before real damage is done, either to the prospects for a successful outcome at the NPT conference, or in the CTB negotiations in Geneva.

—*Tom Zamora Collina*

Edward A. Shils

Edward A. Shils, one of the world's most distinguished sociologists, a champion of intellectual freedom, and a founder of the *Bulletin*, died January 23 at his home in Chicago. He was 84.

Although not a natural scientist, Shils had a passionate interest in devising ways to rein in nuclear weapons in the post-war years. That led him to work closely with the Atomic Scientists of Chicago, the group of former Manhattan Project scientists who started the *Bulletin* at the University of Chicago in December 1945. For 16 years, he served variously on the *Bulletin*'s Board of Directors or its Editorial Board.

Four founders of the *Bulletin*, University of Chicago, 1946: From left, biochemist Harrison Davies; sociologist Edward A. Shils; biophysicist Eugene Rabinowitch; physicist John A. Simpson.

Shils wrote often for the *Bulletin*, his prose as direct as a hammer swung by a master carpenter. In early 1954, when J. Robert Oppenheimer's loyalty was questioned by the Atomic Energy Commission and his security clearance suspended, Shils wrote: "The action of the AEC is the lowest level reached by an administration which seeks to show its disapproval of Senator McCarthy by running as fast as it can to keep up with him. Our country is being severely and irreparably damaged by such cheap politics and wooden-headedness masquerading as respectability."

Later, when the AEC's Personnel Security Board endorsed the suspension, Shils wrote: "Unwittingly, moderate conservatism has come to accept the postulates of nativistic fundamentalism—of know-nothingism, of crackpot xenophobia, of McCarthyism. . . . We have gradually moved from guilt by performance and intention to guilt by association; from guilt by association to guilt by inadvertence or personal susceptibility to pressure; now we have come to guilt by failure to contribute to national security up to the full limits of one's talents, and guilt by insufficient enthusiasm."

Throughout his career, which began at the University of Chicago in 1938, Shils systematically challenged conventional thinking in sociology and

social anthropology, as he sought to combine the empirical tradition of the Chicago school of sociology with the theoretical thinking of European social scientists. From 1945 until 1977, he held a series of joint appointments in sociology— Chicago continued to be his American home, but he also taught at the London School of Economics, Cambridge University, and the University of Leiden.

In 1962, Shils founded *Minerva*, a leading journal of the social, administrative, political, and economic problems of science and scholarship. *Minerva*, which has a worldwide circulation, is published in Britain.

A dozen years later, a commentator writing in *The Times* of London said: Shils "is essentially an intellectual's intellectual, and scarcely a corner of the Western cultural tradition has not benefited from the illumination afforded by his penetrating and often pungent attention."

That distant rumble

For decades, opponents of a comprehensive test ban have argued that complicated "on-site" inspections and special techniques would be needed to verify any ban on nuclear tests. For one thing, they said, from a distance it would be extremely difficult to identify a small nuclear test among the many large chemical explosions that are set off each year for mining and construction.

Although the seismic signatures of nuclear and conventional explosives are different, test-ban opponents argued that a verification team would soon get bogged down combing through the seismic records of the thousands of conventional explosions that occur each year.

Ironically, Paul Richards of Columbia University's Lamont-Doherty Earth Observatory in New York State now claims that nuclear and conventional explosions can be distinguished relatively easily—but only if monitoring is done at long distance (*New Scientist*, December 17, 1994).

Richards reported to a 1994 meeting of the Geophysical Union that, in reviewing seismic records, he found another way to distinguish between explosions. Although many conventional explosions register a shock of the same magnitude as small nuclear explosions, the conventional blasts register only on nearby seismographs.

Richards thinks this is because most of the energy in commercial explosions is spent lifting and loosening rock. In contrast, underground nuclear tests are specifically designed to minimize local destruction; as a result they shake the earth more than they move it.

If Richards's theory holds up, test ban monitors would need to investigate only the one-in-a-thousand conventional explosion that is recorded as far away as 2,000 kilometers or more.

—*Linda Rothstein*

Tom Zamora Collina is the director of policy and research at the Institute for Science and International Security in Washington, D.C. Linda Rothstein is managing editor of the Bulletin.

In brief

■ Don't phone home

Newt Gingrich's description of the high-tech future does not always ring true in the high-tech present. Describing the wonders of the future battlefield, he said: "CNN will be in your living room. . . . You will be able to see the battlefield. You'll then be able to pick up the telephone and call your son or daughter who are watching in the firefight. . . . You will chat with them about your view of how they're conducting their squadron operations. This is all literally true." (Cited in *Defense News*, February 13, 1995.) Gingrich's pronouncement came just days after Israel's defense minister banned private portable telephones from military facilities (*Defense Media Review*, February 1995). It seems that an increasing number of Israelis on military duty have been using cellular phones to conduct private business during duty hours. It turns out that all that chatting plays havoc with military discipline.

■ Hitler's hideaway as hot potato

In May 1945, the U.S. army confiscated Nazi property in Berchtesgaden and nearby Obersalzberg Mountain, a Bavarian ski resort area where Adolf Hitler and the Third Reich's elite once frolicked. Now, after 50 years—during which time countless American troops and their families vacationed in the area—the army has decided to give it back, even though the German government doesn't want it. Bavarian officials want the Americans to keep the property for at least 10 more years to prevent neo-Nazis from visiting Hitler's former mountain retreat (*Baltimore Sun*, February 20, 1995).

■ Teller wants more

The General Accounting Office and the Galvin Task Force have weighed in recently on the fate of the Energy Department's weapons laboratories, both recommending at least some reductions in personnel and activities. (For details on the Galvin report, see page 42). During the debate, however, one dependable voice continued its ominous rumble: According to Edward Teller, the post–Cold War era needs more, not fewer, nuclear weapons systems. "For such reasons," he said, "I suggest that military developments in the Department of Energy should continue, moreover across a broad front" (*Chemical & Engineering News*, February 13, 1995). Teller thinks not only Los Alamos and Sandia, but also Livermore (which he founded), should continue as a weapons lab, to speed new weapon design.

■ Peace dividend update

Perhaps someone else has been listening to Teller. The Clinton administration's proposed Energy Department budget for 1996 calls for a 4 percent reduction in energy research (albeit with a $65 million increase in nuclear research), but an additional $106 million for weapons research, development, and testing, for a total of $1.6 billion.

■ Secret—or dumb?

More ammo in Democratic Sen. Patrick Moynihan's campaign for the dissolution of the Central Intelligence Agency? A Justice Department report, quoted in the Feb-

ruary 20, 1995, *Nation*, complained that the CIA had difficulty producing information about its activities during the pre–Gulf War period. Trying to track loans and weapon sales made to Iraq, Justice eventually got some CIA information from "specialized offices that previously were unknown to the CIA personnel who were assisting us." "In one instance," said Justice, "it took the CIA two months to identify the intended recipient country of weapons shipped at the CIA's request."

■ Counting (radiation-free) sheep

The British Ministry of Agriculture, Fisheries and Food has partially lifted the ban on eating sheep raised in some areas of Cumbria (*New Scientist*, January 28, 1995). The ban dates back to 1986, when British farmland was contaminated by radioactive fallout from the explosion at the Chernobyl nuclear plant in Ukraine. The decision to remove the restriction will allow farmers to take some 63,000 sheep to market, but leaves undecided the fate of another 70,000 contaminated sheep on nearby farms.

■ Widening the customer base

Russians and East Europeans see a growing law-enforcement market for traditional military hardware. At "Defendory 1994," an arms show held in Athens in December 1994, Russia's Kalashnikov Joint Stock Company stressed its interest in commercial sales, noting that increased crime inside Russia has meant greater domestic demand for submachine guns, machine pistols and handguns for private security guards, police, and paramilitary units (*National Defense*, February 1995).

■ Bait and switch?

In a bid to persuade Congress to buy more B-2 bombers, Northrop has been telling members that it can build another 20 of the Stealth aircraft for the fire-sale price of $11.4 billion, or $570 million apiece. But only Northrop can figure out how the price could have dropped from the current charge of $2.2 billion apiece. "I don't know where Northrop is coming up with their numbers," says William Myers, a weapons-cost-estimate expert at the Congressional Budget Office. According to Myers, the variation in cost of the already ordered B-2s has defied logic—the B-2's price increased after production revved up. So far, he says, "the more you buy, the more expensive each plane gets" (*Time*, January 30, 1995).

■ Taking his word for it

In court in March was a case against Teledyne that dates back to 1984, when the company shipped weapon-grade zirconium to Carlos Cardoen, perhaps the most famous of today's international arms merchants, who used the material to build cluster bombs. In March, a former employee, Edward Johnson, told a Florida court that the company assured employees that the material Teledyne sold to the Chilean weapon merchant was not being used in weapons. That was based solely on Cardoen's response to a Teledyne communiqué on March 21, 1984: "Please verify and assure us by return telex that product is being used for non-military operations" (Associated Press, March 15, 1995).

25 years ago in the *Bulletin*

The June 1970 special issue of the *Bulletin* marked the twenty-fifth anniversary of Trinity, the first atomic test in the Nevada desert. Among the authors was Glenn Seaborg, then chairman of the U.S. Atomic Energy Commission, who was asked to speculate about the impact of things nuclear in the coming 25 years.

Seaborg's essay reflected the scientific optimism of the day regarding the peaceful uses of nuclear energy. Taking the time to "indulge in a great deal of wishful thinking," he couched his predictions in the form of "reminiscences" by an "old-timer" at the 1995 dedication of the first commercial fusion reactor.

"We've come a long way in those 50 years. We've come from fear to mistrust to understanding to confidence in our affairs with the atom. . . . The atom's energy used in infinite variety is the lifeblood of our society. It lights, heats and cools our cities and homes. It powers our industry. . . . On its tireless energy, space vehicles move to and from the planets with men and scientific packages . . . and automated nuclear ships silently ply the seas carrying huge cargoes."

And the breeder reactor, dedicated in 1995, would finally fulfill one of nuclear energy's promises: "As was pointed out at the dedication of that 3,000 electric megawatt breeder plant, the American taxpayer would now begin to realize a huge payoff, eventually hundreds of billions of dollars on [his] investment."

Seaborg also predicted that nuclear science would revolutionize modern medicine—and one might wish that all, not just many, of his predictions had come true:

"Over the years we saw the development and use of such things as miniaturized neutron-emitting probes and needles that were extremely effective in knocking out isolated tumors; *in vivo* neutron activation analysis to diagnose certain total body conditions; a variety of ultrapure vaccines to conquer and immunize against many virus- and parasite-borne diseases; a pocket-sized hemodialyzer (an artificial kidney) available to anyone who needed it at a cost of pennies per day; an implantable isotopic-powered heart pacemaker that would regulate an erratic heartbeat for 10 years before replacement of its power source became necessary; and a completely artificial heart. . . .

"Most major hospitals had a wing devoted solely to this specialty with unique medical accelerators, low-dose radiation facilities and a variety of scanners, counters, and analyzers operated by specially trained and highly skilled operators."

THE *BULLETIN* WELCOMES LETTERS FROM ITS READERS, but reserves the right to edit for length and clarity those letters accepted for publication. Letters to the editor can be e-mailed to **bullatomsci@igc.apc.org** or sent to *The Bulletin of the Atomic Scientists*, 6042 S. Kimbark, Chicago IL 60637.

ZAGALSKY

A perilous profession

If no one can protect journalists, who will protect democracy?

When a Russian television anchorman finished his sad report on the murder of Russian Public Television Executive Director Vladislav Listyev, he looked into the camera and said: "Who is the next?"

Then there was a minute of silence.

Thirty-eight-year-old Listyev, one of Russia's most prominent journalists, was shot dead near his apartment in Moscow on March 1. The murder shocked the country even more than that of Dmitri Kholodov, a reporter for *Moskovski Komsomolets* who was killed in October when he opened a booby-trapped briefcase.

Since the days when journalists served, in Lenin's words, "as nuts and bolts of the Communist Party machine," the profession has become extremely dangerous in Russia. During the first three months of 1995, four journalists were killed, one was wounded, and two more disappeared.

■ Vyacheslav Rudnev, a freelance journalist from Kaluga (a city outside Moscow), was found February 13 in the hallway of his apartment building with a fractured skull. He died in the hospital four days later. Rudnev was known for his exposé-style reporting in regional newspapers like *Znamya* and *Vest*. Prior to his murder, he had apparently received death threats, which he reported to the police. There are no clues as to who killed him, or why.

■ Igor Kaverin, a 24-year-old radio engineer with "Svobodnaya Nakhodka" (Free Nakhodka), was shot to death in the far eastern town of Nakhodka on March 3. The circumstances of his death also remain unknown.

The crisis in Chechnya presented more danger. Two journalists were killed during the fighting in 1994. Officials in Moscow bitterly criticized television reports unfavorable to the government's actions in the conflict. The Russian military ordered journalists out of the war zone, jammed their satellite transmissions, exposed their film, and occasionally took potshots at reporters' cars. The press responded with some of the best independent reporting Russia had ever seen—but the price was too high.

■ Jochen Piest, a correspondent for the German news magazine *Stern*, was killed, and *Rossiskaya Gazeta* correspondent Vladimir Sorokin was wounded in a Chechen suicide attack in Chervlyonna, about 15 miles northeast of Grozny. A Chechen rebel ran a small diesel locomotive toward an empty Russian troop train while firing a submachine gun. The reporters threw themselves to the ground, but Piest was hit by three bullets and Sorokin was hit in the leg. The gunman died when the locomotive collided with the military train.

■ Maxime Chabalin and Felix Titov of the St. Petersburg daily *Nevskoe Vremya* have disappeared in Chechnya. Chabalin, the assistant political editor, and Titov, a photographer, left Nazran on February 27 for their fifth trip to Chechnya since the fighting began. The two were due back on March 4, but as the *Bulletin* was going to press at the end of March, they had not been heard from since their departure.

I have heard from many people that contemporary Russia reminds them of Chicago in the 1930s. They say it is the same type of crime, gangsters killing gangsters. Newly emerged businesses are trying to monopolize everything and wipe out every possible competitor. The contrast in people's lifestyles is enormous; either one is incredibly rich or horribly poor. There is no middle class.

But at least Chicago gangsters had a couple of "rules"—do not harm "civilians," and never go after newspapermen. If either of these rules was violated, the city's newspapers would come down hard on the gangs—and the newspapers could investigate far better than the police.

In June 1930, *Chicago Tribune* reporter Jake Lingle was gunned down as he walked to a commuter train in downtown Chicago. He wrote extensively on the gang wars, so most people assumed that Al Capone was behind the hit. The *Tribune* declared "war" against the gangs.

The war didn't last long. The *Tribune*'s own sources found that Lingle had been on Capone's payroll.

Russian newspapers probably don't have the same resources that the *Tribune* had back then. As in 1993 and 1994, neither reporters nor police have come up with a single clue to these murders of journalists. I am pretty sure that they will never find those who ordered the deaths of Listyev, Rudnev, Kaverin, Kholodov, and the others. I am also pretty sure that those who were killed were just doing their jobs as journalists.

Reporters are scared. The chief investigator for Listyev's murder recently complained that he can't really talk to journalists about the case. Even Listyev's friends and colleagues refuse to talk. A friend of mine, whose articles have exposed corrupt bureaucrats and the government's dirty deals, said that he was now afraid to gather information and has slowed his crusading pen.

If the government cannot find a way to stop the killing of journalists, the consequences will be unpredictable. The Russian press is the only institution in the country that stands for democracy.

In 1930 the *Chicago Tribune* apologized to its readers for Lingle's indiscretions. In 1995 there is no need to apologize. Journalists are not guilty.

Who is the next? ■

Leonid Zagalsky, a Russian-trained journalist, is a project coordinator tracking developments in the former Soviet Union and Eastern Europe for the New York City-based Committee to Protect Journalists. He is a Bulletin *contributing editor.*

Scientists, police still puzzling over uranium seized in the Czech Republic; Congress may not give the military more

NUCLEAR SMUGGLING

Which Fissile Fingerprint?

By MARK HIBBS

Like their German counterparts, Czech investigators are finding that pinpointing the source of smuggled fissile material is more complicated than they first expected. The more the experts discover, the more new, unanswered questions emerge.

Since last summer, when German officials claimed that the five grams of smuggled weapons-grade plutonium they seized in May 1994 had a "fingerprint" that could be traced to Russia's nuclear weapons, laboratory experts in Germany, in the Czech Republic, and at the International Atomic Energy Agency (IAEA) in Vienna have been poring over bits of highly enriched uranium and plutonium that have turned up in central Europe. In December, a uranium cache was found on the back seat of a car parked on a Prague side street (see "Czechs Seize Migrating Uranium," March/April *Bulletin*).

Because no two nuclear processing facilities are exactly alike, any fissile material that has been enriched or burned in a reactor and then reprocessed and separated should theoretically bear a tell-tale signature that reveals its source. Because batches of fissile materials vary, it is also theoretically possible to tell when and where inside a facility a sample was generated.

In addition to using mass spectrometers to precisely measure the amounts and ratios of key isotopes, analysts can also detect impurities—certain lead, tin, or copper compounds, for example—which may be part of the signature for specific plutonium separation plants, fuel fabrication facilities, centrifuge cascades, or laser enrichment laboratories. Standard safeguards laboratory techniques can isolate these compounds in concentrations as low as a few parts per trillion.

But, so far, the complicated makeup of both the highly enriched uranium and the plutonium seized in central Europe does not fit any known nuclear weapon or reactor fuel recipes. "We're contending with a whole forest of isotopes and compounds," one German analyst said.

The U.S. Energy Department asserts, in an affidavit that will be used as evidence in court, that the plutonium recovered by German police last May is a "standards sample" that was purified in a laboratory. Energy Department officials believe the five grams were diverted from a total inventory of a couple of kilograms which, over two decades, was distributed to physics labs all over the former Soviet Union and its former satellite countries, including East Germany.

In contrast, German officials claimed last spring that it came from a weapon source. Now, according to internal reports, the Bundeskriminalamt (BKA), Germany's criminal justice investigation agency, is not sure where the plutonium came from.

Nor do they know the source of 350 grams of plutonium seized at the Munich airport last August. Euratom recently told the European Parliament that the material was produced in one of a dozen Chernobyl-type RBMK reactors in Russia and Ukraine, and then separated and made into reactor fuel. The Ministry of Atomic Energy in Russia claims the material was diverted from Germany.

The source of the 2.7 kilograms of highly enriched uranium nabbed in Prague in December is equally mysterious. A spectrometric analysis of the material by the Rez Nuclear Research Center near Prague revealed that it consisted of 11 percent uranium 238 and 87.7 percent uranium 235, with just under 1.1 percent uranium 234 and 0.2 percent 236, but no clear trace of uranium 232.

Because uranium 236 is not found in natural uranium, its presence led Czech officials to conclude in January that the material had been irradiated in a reactor and then recovered in a reprocessing plant and re-enriched.

But that early theory has not met with universal agreement. Other European and U.S. government scientists have offered different and contradictory theories.

■ At one U.S. national laboratory, scientists argue that the sample contains too little uranium 236 to have been burned in a reactor and then recovered and re-enriched. They say that even low-burnup fuel should contain nearly 50 times more uranium 236.

Highly enriched uranium produced in the United States using fresh uranium feedstock, not reprocessed uranium, typically contains about 0.44 percent uranium 236. But the amount of uranium 236 in the product could be cut in half by increasing the tails assay of the uranium, allowing more of the desirable uranium 235 isotope to be discarded as waste after enrichment. One such sample, produced in a U.S. gaseous diffusion plant, consists of 88 percent uranium 235, 10 percent 238, 1.8 percent 234, and 0.2 percent 236. These values are very close to those of the Prague find.

■ Meanwhile, some scientists—including physicists at Euratom and one of the U.S. weapons labs—suggest that the Prague cache might be a "cocktail" composed of uranium from several sources, some of which contained uranium 236. Such a cocktail might have been concocted expressly to thwart any effort to trace the ma-

terial to its source. One senior weapons lab scientist said, "In our view, it's likely that they started with reprocessed uranium and then added other materials. The possibilities are endless."

■ Still another theory—this one supported by a diverse group of Europeans and Americans—holds that the amount of uranium 236 in the Prague sample is consistent with material that has been reprocessed into low-enriched uranium from spent RBMK fuel. They calculate that, with a discharge burnup of 20,000 megawatt-days per metric ton of uranium, the level of uranium 236 would be about 0.25 percent.

Another puzzle concerns the apparent absence of uranium 232. Like 236, 232 is not believed to be found in natural uranium, and its presence also may indicate irradiation. Uranium 232 is an undesirable constituent of reactor fuel because it decays into a stable isotope, lead 208, which absorbs neutrons. Experts at Euratom's Transuranian Institute say that some samples of Soviet fuel that they have analyzed recently show that Russia solved the 232 problem by blending reprocessed uranium with other feedstock. This, officials say, was the standard Soviet procedure in the production of naval propulsion fuel.

All of these theories boil down to a simple fact: In the absence of a matching "fingerprint," there is as much guesswork on the scientific side as in the sleuthing process. As one U.S. scientist put it, "If they can't nail down what kind of feedstock they're using, any attempt to get to the source will be a blind fishing expedition."

The IAEA has compiled records of all the fissile-material processing facilities it safeguards worldwide. But it has no access to equivalent records from the five nuclear weapon states, and Czech investigators ran into a brick wall when they tried to pursue leads suggesting that the uranium they found had been diverted from Soviet naval fuel stocks.

Investigators report that the two metal containers in which the Prague uranium was found by police had identification numbers traceable to a storage compound in Odessa belonging to the Black Sea Fleet. This raises more questions, because the Black Sea Fleet is not known to include any nuclear-propelled vessels.

Czech police believe that bandits with connections to Russia's Northern Fleet (see "Potatoes Were Guarded Better," page 46) might be shunting stolen submarine and icebreaker fuel to Ukraine before trying to sell it elsewhere. Via Interpol in Lyon, the Czech government asked Moscow for assistance in solving this puzzle. But "they have simply ignored our official requests," one Czech official said. Russian officials say they will not cooperate unless they can conduct their own laboratory tests.

Without Russian help, the Czech Republic has relied on help from the BKA in reaching one important preliminary conclusion: The uranium seized in Prague, as described in documents that were in the hands of the suspects who were arrested, is identical to that of 800 milligrams of highly enriched uranium German police seized in Landshut last year. And Euratom has concluded that the Landshut material could have come from naval propulsion fuel.

Initial spectrometric analyses have strengthened this line of inquiry. If it can be proven that the two samples are identical, investigators will be satisfied that the thieves were not tapping into recent outputs from Russian gas centrifuge enrichment cascades.

That is because a large portion of the sample confiscated in Landshut is not in the form of uranium dioxide, the common end product of fuel fabrication plants, but is instead a more stable derivative oxide, uranium 409, which forms over time in the presence of ambient air by the binding of two uranium dioxide molecules with an oxygen atom.

According to European safeguards officials, analysts estimate that the Landshut material may have been enriched in the form of uranium hexafluoride, and then reconverted to uranium dioxide for use as fuel in 1985 or before. Since then, it has gradually been forming uranium 409.

"If it turns out that the uranium is from an old inventory, that's good news," one European safeguards official said. It would lend credence to Moscow's assertion that, despite the crumbling of central control, it is still protecting its enrichment plants against diversion.

According to the Russian safeguards agency, Gosatomnadzor, there are 900–950 discrete inventories of nuclear material in the former Soviet Union. And there may be many tons of highly enriched uranium in aging Russian stockpiles where uranium dioxide is slowly being transformed to uranium 409. ■

Mark Hibbs is European editor of Nuclear Fuel *and* Nucleonics Week *in Bonn, Germany.*

Hawks Take a Hit

By JOHN ISAACS

The first shots in the 104th Congress's battle on national security issues have been fired. The final outcome won't be known until fall, but the early skirmishes suggest that, although the Pentagon hawks are in charge of the levers of power, they are not quite in control. Republicans may command majorities in both houses of Congress and their stalwarts chair the committees, but the hawks in their midst are not likely to win sweeping changes in policy.

On February 15, Cong. John Spratt, a moderate Democrat from South Carolina, offered an amendment to H.R. 7, a Republican national security bill, that effectively shot down the Republican "Contract with America" promise to resuscitate Star Wars. His amendment was part of a broad Democratic strategy to force Republicans to make difficult choices regarding defense issues.

Republicans had been scoring points on President Bill Clinton by charging him with letting military readiness slip. Spratt decided to test whether Republican rhetoric on readiness exceeded Republican Star Wars fever. He explained on February 15 that he did not oppose a ballistic missile defense—his amendment was simply designed to insure that Pentagon programs would be funded in order of importance: "Readiness first and foremost, that is the first priority; theater missile defense over national missile defense, and national missile defense would have to start with ground-based interceptors rather than space-based interceptors."

Star Wars slayer, Cong. John Spratt.

No one expected Spratt to win, least of all Spratt himself. Two weeks before, he had offered a similar provision in the National Security Committee and lost badly, 18–33. Not one Republican supported it in committee.

Confident that a similar fate would befall Spratt's renewed attempt on the House floor, Speaker Newt Gingrich and the Republican leadership skipped a vote check. The Democratic leadership didn't bother to go out looking for votes for Spratt, either. Arms control and peace organizations ignored the amendment.

But to everyone's amazement, the amendment passed 218–212, with 24 Republican votes. Democrats united 193–7 in favor.

Pentagon hawks were stunned; Star Wars had taken a public relations hit. Later that day, they were staggered again when the House adopted an amendment by Nebraska Republican Doug Bereuter. Bereuter's amendment removed a "Contract" provision that would have limited the president's ability to deploy U.S. troops in U.N. operations.

Until February, House Republicans had enjoyed almost complete success with "Contract" items. But Gingrich played down the Spratt vote with a put-on-your-best-face argument: "After something like 145 votes, we finally lost one. We think that's pretty remarkable."

But Republicans were also learning that "Contract" victories in the House could be in jeopardy in the Senate.

First to go was the balanced budget amendment, which had passed handily in the House. It was defeated in the Senate on March 2.

Similarly, on March 16 the Senate revised the House version of a Pentagon supplemental appropriations bill. The Clinton administration had asked for $2.5 billion for overseas operations during the past year for missions in and around Iraq, Haiti, Cuba, Rwanda, and Bosnia. The House of Representatives approved the request, and more, including:

- Another $670 million for Pentagon "readiness" programs.
- The transfer of funds from domestic programs to the military.
- More funding of the military by reducing aid to Russia.

The Senate reversed all three House decisions. It cut the supplemental to $1.9 billion (from the administration request of $2.5 billion and the House-approved level of $3.2 billion), refused to countenance domestic cuts to pay for Pentagon spending, and restored most of the funds for the former Soviet Union.

All three Senate reversals were approved overwhelmingly. The bill was voted out of Oregon Republican Mark Hatfield's Appropriations Committee unanimously and was approved 97–3 on the Senate floor. Final action to resolve differences between the House and Senate bills had not been completed by late March, when the *Bulletin* went to press.

The fate of H.R. 7 and the Pentagon supplemental provides the clearest indication that significant increases in the Pentagon budget—particularly for programs like Star Wars—are in trouble.

House Republicans spent much of March slashing housing programs, job training, school lunches, education, summer jobs, and other domestic programs to reduce the budget deficit and pay for a tax cut. House Democrats could not halt the Republican tide, but they scored fistfuls of political points by accusing Republicans of targeting children and the elderly to fund a tax cut for the wealthy. Charges of unfairness heightened pressure on Republicans to refrain from adding billions to the Pentagon budget.

Cong. David Obey, a Wisconsin Democrat, tried to embarrass the Republicans by offering a "guns-to-butter" amendment to one domestic bill. He proposed a delay in the production of the air force's F-22 fighter, which would have saved $7 billion to be used to restore funds for school lunch programs. Obey, the ranking Democrat on the Appropriations Committee, complained in the House on March 15 that "the bill before us is a contract on kids; the bill before us is a contract on old folks. It clobbers programs for both." House Republicans adopted rules to forestall the amendment.

These early skirmishes suggest that beefing up the military as promised in the Contract with America will be difficult to achieve. However, budget-cutting fervor is sure to hit some "non-traditional" military programs:

- United Nations peacekeeping. The House has rejected an administration request for $670 million in supplemental peacekeeping funds for fiscal year 1995, and it has signaled that further peacekeeping cuts are in the offing.
- Aid to the former Soviet Union. The Senate rejected early cuts in funds to help dismantle Russian weapons, but resentment is building as a result of Russia's sale of a nuclear reactor to Iran and the brutal repression in Chechnya. The program is expected to suffer further cuts ahead.
- Clean-up at nuclear facilities and Pentagon bases. Although few question the government's obligation to clean up the Energy and Defense Departments' messes, the billions targeted for clean-up may be an irresistible honeypot for other projects.
- Economic conversion. Republicans delight in going after Pentagon plans to assist a transition to a non-military economy. The House cut one key conversion program—the Technology Reinvestment Program—by $500 million. The Senate reduced the same program by $200 million.

Hawks who saw a potential gold mine in a Republican-controlled Congress are likely to be disappointed. Instead, they may have to be content with moving funds from one Pentagon ledger to another. ■

John Isaacs, the executive director of Council for a Livable World in Washington, D.C., is a Bulletin *contributing editor.*

Yes, haste made waste

By LINDA ROTHSTEIN

The FBI's raid on Rocky Flats uncovered a toxic disaster—and a management that didn't need to care.

Beginning on page 34, the *Bulletin* takes a look at the mess created by 50 years of building nuclear weapons. The material is based on candid, eye-opening reports recently issued by the Energy Department. Energy now estimates that it will cost more than $200 billion over the coming decades just to hold the line. Forget about "cleanup," the people at Energy say. The best we can hope for is "stabilization."

How did we get into this $200-billion-plus mess? It was easy. Combine secrecy with arrogance and, presto, you're there. Consider some of the thornier cleanup problems that were uncovered in "Operation Moonglow" and the investigation that followed.

In June 1989, the Federal Bureau of Investigation raided Rocky Flats, the Energy Department's plutonium-trigger production plant near Denver, which was then managed by Rockwell International.

Following the investigation, a grand jury heard more than a hundred witnesses as it pondered indictments of Rockwell and individuals employed by Rockwell or the Energy Department. In the end, the case was settled out of court. In March 1992, the company signed a plea bargain agreement, admitted that it had committed environmental crimes, and paid an $18.5 million fine—the largest environmental penalty ever imposed.

As FBI agent Jon Lipsky testified before Congress, serving the warrant on Rocky Flats was tricky: "We had a real big problem because the Rocky Flats nuclear facility is a secret facility. Its access is limited. . . . There are yellow signs with fences all around it that state that it is a federal offense to trespass. There are signs inside the first, initial gates that say that the guards are allowed to shoot, and we knew that just walking in on that facility and trying to conduct a normal—'normal' meaning a regular-type search warrant—wasn't going to work."[1]

An FBI raid on another government agency is unusual, and the FBI acted only after it accumulated a wealth of evidence of wrongdoing. For instance, Lipsky cited the findings of Colorado Department of Health inspectors who visited the plant in June 1988: "Although [they] were barred from a number of areas based on national security concerns, a number of RCRA [Resource Conservation and Recovery Act] violations were observed in other areas. The facility's operating records did not accurately track hazardous wastes. The storage logs and the plant's computerized hazardous waste data base were not consistent. The data base still did not contain information that *must* be known in order to comply with RCRA's regulations, such as dates of storage, compatibility of wastes and various information on radioactivity. Wastes were marked with wrong compatibility codes and some incompatible wastes were stored together."[2]

Not every plant, of course, has the same problems as Rocky Flats. Many, however, have similar waste handling problems. Three of Rockwell's problems, uncovered by Moonglow and the subsequent investigation, concerned:

"Pondcrete"

Rocky Flats workers poured low-level mixed (hazardous and radioactive) wastes into outdoor "solar ponds." There the volume was supposed to be reduced by evaporation—but it was also reduced by leakage. Semi-solid wastes formed sludges that sank to the bottom.

In response to complaints that the leaking solar ponds had contaminated the groundwater, in 1986 managers for Rockwell International told the Colorado Department of Health and the Environmental Protection Agency that the company would close down and clear out the ponds.[3]

This was easier said than done. One pond—207A—measured 250 by 525 feet, and was 10 and a half feet deep; it held about 5,000,000 gallons of water. At the time Rockwell decided to close it, the pond contained about 150,000 cubic meters of sludges.

According to Rockwell's own report, in non-solid form these sludges were "a corrosive and reactive hazardous waste, and [by Environmental Protection Agency standards] toxic for cadmium, chromium, barium, lead and silver." The sludges had to be solidified before they could be shipped to the Nuclear Test Site (NTS) for burial.

The sludges were dredged from the pond, mixed with Portland cement, and poured into plastic-lined cardboard boxes. The mixture was supposed to form a solid slab of pondcrete. Each slab had a volume of about 15 cubic feet

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and weighed between 1,500 and 1,800 pounds.

Some pondcrete had been sent to the Nevada Test Site before the decision was made to close the ponds. But the earlier shipments had been stopped when, in 1985, a slab broke while being put in place, and its unhardened contents were spilled. John Boland, an NTS health physicist, informed Rocky Flats that any future shipments must consist of concrete-hard blocks of waste material, and he suggested that in the future blocks should be tested for hardness using a "penetrometer."

While waiting for permission to resume shipping the slabs to the test site, Rockwell stored blocks of pondcrete and a similar product, "saltcrete," in Rocky Flats buildings 788 and 374, where they were produced. As the boxes began to pile up, though, the company decided to move the slabs to an outdoor parking lot.

To speed production, workers were told that the pondcrete need only reach the consistency of putty after 72 hours. But if a slab was putty 72 hours after mixing, putty it remained. One worker reported that he sank up to his ankles when he walked across the slabs.

To make it more likely that these mushy blocks would pass inspection, workers used "the thumb test" in the area on the slabs where the penetrometer was invariably inserted. If they could poke a thumb into the pondcrete, it was too soft or damp. In that case, the point where the penetrometer would later test the block might be "capped" with a coffee can lid and additional concrete.

After a winter exposed to the elements, many of the blocks piled up in the parking lots were in bad shape; much of the pondcrete had not solidified. Still, more pondcrete was being churned out. By summer, the parking lot was full of boxes, and another outdoor storage pad, the "904" was built.

No permits were obtained for these new "storage areas," and no one from Rockwell bothered to tell either the Environmental Protection Agency or the Colorado Department of Health that the parking lot—where leaking material was now washed away by rainwater—constituted a new source of pollution.

No corrective action was taken until May 1988 when, after a particularly heavy rainfall, a box fell, spilling its contents over the 904 pad. Other boxes also collapsed, but their contents were held in place by their plastic liners.

The spill occurred shortly after new pondcrete shipments to the Nevada Test Site had been approved—one shipment had already been sent. After they learned about the spill at Rocky Flats, officials at NTS examined the shipment they had received. They also found leaking slabs. Authorities at the test site barred any more shipments from Rocky Flats.

Spraying

Rocky Flats "disposed" of waste water by "spraying" the grounds—at a rate of about 80 million gallons of water a year. The water was supposed to "drain" off by soaking into the ground. The plant ran its spraying equipment day and night, summer and winter. The fields were so waterlogged that even in the hottest weather the spray would run off, eventually entering nearby streams. FBI Agent Lipsky said that in the winter, Rockwell's "mucky-mucks drive by the spray field and they can see the ice domes, they can see that there is no drainage occurring." When an Energy Department employee—who passed the spraying equipment and saw the runoff—reported the matter to the same managers, they told him it couldn't be happening.

The chromic acid spill

In February 1989, an employee forgot about a hose that he was using to fill a large chromic acid tank in Building 444. During the night, liquid in the tank overflowed into a waste acid tank, and, when that was filled, it flooded the immediate area and eventually breached a protective berm. The spillover ran down the floor to a drain, and from there to the sewage treatment plant. From the sewage plant, the chromic acid went into a holding pond, from which it was dispersed over the grounds by the spray-irrigation system.

Many of the biological organisms at the sewage plant were killed, but it was six days before Rockwell connected the chromic acid spill with sewage plant problems. During the crisis, 2,763,000 gallons of chromic acid-contaminated water were disposed of by spray-irrigation.

When Rockwell managers realized what had happened, they decided to continue spraying the contaminated water—onto the frozen ground.

Why?

Many involved in the weapons production process have relied on claims of ignorance to explain how the weapons complex came to be in its present sorry state. Others say that times have changed, that there is now greater sensitivity to the dangers of environmental degradation.

Although there is some truth to both of these claims, other factors also played a part in producing the expensive mess that must now be dealt with.

For many years the nuclear weapons enterprise was conducted with a sense of urgency behind a veil of national security; secrecy meant that *all* of its activities were shielded from public scrutiny. The Cold War atmosphere encouraged an us-versus-them mentality, and any critic of the weapon-building process could be readily dismissed as siding with "the enemy."

And perhaps government secrecy and the profit motive make a particularly toxic brew, as was the case at Rocky Flats. Private contractors operated (and continue to operate) much of the weapons complex. Their contracts—which rewarded only speedy production—encouraged behaviors that not only violated common decency, but frequently, the law; and their agreements with the government shielded them from penalties. Until 1992, the government paid not only any legal penalties they might incur, but reimbursed—to the last penny—their attorneys' fees. ■

1. U.S. Congress, House, Committee on Science, Space, and Technology, *Environmental Crimes at the Rocky Flats Nuclear Weapons Facility, Hearings, before the Subcommittee on Investigations and Oversight*, 102nd Cong., 2d sess., 1992, vol. 1, pp. 407–408.
2. Attachment 3, Application and Affidavit for Search Warrant, reprinted in *Environmental Crimes*.
3. Plea bargain agreement, reprinted in *Environmental Crimes*.

Hiroshima Memories

By HIDEKO TAMURA FRIEDMAN

One sunny day, a young girl learned about darkness.

Today I live in the United States where I'm a social worker in the Radiation Oncology Department at the University of Chicago Hospitals. The work is rewarding. Over the decades, the diagnostic and therapeutic uses of ionizing radiation have probably helped millions of people around the world.

But just a few blocks away is a monumental bronze sculpture by Henry Moore. It is called "Nuclear Energy," and it marks the spot where Enrico Fermi's talented team of Manhattan Project physicists achieved the first self-sustaining chain reaction in December 1942. To me, "Nuclear Energy" terrifyingly resembles a mushroom cloud, and I avoid going near it.

Perhaps that is because I recall a warm sunny day in another city, when I was a child of 10. On that day, August 6 in Hiroshima, the sun and the earth melted together. On that day, many of my relatives and classmates simply disappeared. I would never again see my young cousin Hideyuki, who had been like a brother to me, or Miyoshi, my best friend. And on that day of two suns, my Mama would not come home for lunch.

Mama and Papa

Tokyo was my home until Japan invaded China. During the war, Papa was drafted into the Imperial Army in 1938. He first served as a private in Northern China; after Pearl Harbor, he became a high-ranking logistics officer based in Hiroshima, his home city.

During most of the war, Mama and I lived with Papa's family, the Tamuras, one of the most respected families of the city. Their home—actually, a large and elegant estate on the Ota River, just over a mile from the center of Hiroshima—would be a war-time refuge. The Tamuras would make sure Mama and I were well cared for.

Papa, Jiro Tamura, was the second son of Hidetaro Tamura, the founder of the Tamura cartel, a combine that produced sewing needles and rubber goods. It had branches in China and Manchuria, and employed about 3,000 people. Grandpa Tamura was a kindly man, even in business. Among his workers were handicapped men and women only he would hire. He made sure the job was fitted to their abilities. I especially remember "Bensan," who had severe curvature of the spine. He had light duties at the factory, and he used to help in the gardens at the Tamura estate. I also remember the time a man who had become unhappy at work climbed to the top of a 60-foot chimney. Grandfather shut down the factory so the man would not be harmed by heat and smoke, and he waited for the man to tire and come down. Grandfather died of a heart attack before the end of the war. Perhaps that was not such a sad thing.

My Papa had thick, dark brown, curly hair, quite like the painter he had always wanted to be. He was of average height, but wiry and powerful. His sturdy shoulders carried me as we strolled among the *Yomise* vendors after supper. During the week, he worked for Nissan Motors in Tokyo as a salesman. On weekends, he painted. In earlier years, he had wanted to attend the Tokyo Art Institute rather than law school. But his parents did not permit him to do that. "Art" was not a substantial profession for a Tamura man.

My mother, Kimiko Kamiya, was "Mama" to me, never Oka-san (mother). She was slender and tall. Her large, expressive eyes, long thick eyelashes, and well-defined eyebrows were not typical Japanese features. She was striking when she dressed up; heads turned when she walked down the street.

Like other Japanese mothers, she was always busy cooking, sewing, knitting, and cleaning house. She made all my clothes, and

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"Hiroshima Memories" was adapted from a longer unpublished work, "One Sunny Day," by Hideko Tamura Friedman, a therapist in private practice and part-time social worker in the Radiation Oncology Department at the University of Chicago Hospitals. She was a child in Hiroshima when the city was destroyed in 1945 by an atom bomb. She came to the United States in 1952, after finishing high school.

Hideko Tamura spent the war years on the estate of her grandfather, a leading Hiroshima industrialist. This portrait was taken on the estate in early 1942. In the front row, from left: Hideko's mother, Kimiko; Hideko; her father, Jiro; and her grandfather, Hidetaro. In the back row: Aunt Kiyoko; Aunt Yoshiko; Grandmother Tamano; Cousin Hideyuki; and Uncle Hisao. The Tamura home was destroyed by blast and fire; the photos on these pages came from members of the Tamura family who lived elsewhere.

she was a speedy knitter. Everything seemed effortless to her, whether making dolls or teaching me how to fold an origami "ghost" on a rainy day. Step by step, she took me through the intricate folding process with the simple square papers. It was like magic.

Years later, I saw "The King and I," and I was reminded of Mama. Like Anna, she shared her open spirit with others by singing. Her voice was soft, humming tunes new and old—Scottish, Irish, German, French, Italian, Russian, and, of course, Japanese.

Mama was not "traditional." She had great affection for Western culture and clothing. So did Papa. The story books they bought me included *Aesop's Fables* and Andersen's fairy tales. Snow White, Sleeping Beauty, Cinderella, and Hansel and Gretel were part of my life, as were Robinson Crusoe, Tom Sawyer, Huck Finn, and Robin Hood of Sherwood Forest.

After moving to the Tamura estate in Hiroshima, my cousin Hideyuki became my brother-in-residence. He knew little about life in Tokyo. But he was a master climber, a catcher of insects, and an excellent player of marbles and paper pachinko. I learned and practiced his crafts so we could play together. He loved having a playmate.

When Hideyuki was occupied, the vast garden of the estate was at my disposal. There were beautifully shaped pine trees, giant rocks, and stone lanterns. Azalea bushes, flowering trees, evergreens, and maples were laid out so that one was awed by beauty from any vantage point. In the winter, the camellias bloomed in bright red, pink and white, next to shiny green holly leaves with red berries. Early spring brought azaleas of every color, as well as aromatic golden and silver lilacs. Condiment plants grew in shady spots, and a small orchard produced figs and persimmons. Besides birds and insects, there was a variety of stunningly colored lizards and large ground frogs covered with unsightly warts.

Shortly after our arrival in Hiroshima, Papa reported for duty. After basic training, he was assigned to the transport division because of his driving experience from his Nissan days. Despite the patriotic fervor of the time, we were secretly delighted that he had not been assigned to the infantry.

On the morning of father's departure to the China front, the Tamura clan gathered at Ujina harbor with festive foods and sake. Decanters were filled and emptied quickly. Men sang send-off songs; women filled plates for the men. I was very sad; my Papa was leaving, but no one seemed to grieve. The family congratulated him for having the good fortune to serve his country and his emperor. Afterward, Mama tried to comfort me. But she, too, wept.

Serving the supreme master

News of the declaration of the Greater East Asian War reached our family on December 8, 1941, in the sixteenth year of the Showa Emperor. I was only six years old when the war expanded to include the United States and Britain, and I could understand very little of

Hideko and her mother at their home in Tokyo.

what was happening. But I sensed that something terribly wrong was taking place, and I knew that I could no longer see American movies, which I loved. "Hush," I was told. I mustn't even speak of American movies to others. Papa, who had just come home after serving a tour in China, was called back to the army. He would soon become an officer supervising transportation on the Inland Sea. His headquarters would be in Hiroshima, and he would be able to come home at night.

My school in Hiroshima was the elite Seibi Military Academy, which my father and his brother, Uncle Hisao, had attended. Seibi Academy, run by the Imperial Army in the ancient Samurai tradition, was far more rigorous than public school. It was like an austere military compound, with tall, green poplar trees bordering spacious school yards. The teachers were firm and demanding, but well liked. Inside the school gate was a stone structure like a mausoleum, in which were the *Goshinei*, the sacred pictures of the emperor and the empress. One was not permitted to walk past it without offering some expression of deepest respect and humility. We were taught to offer our deepest and most reverent bow, the *Saikeirei*.

That made me think of a day at my school in Tokyo, when the emperor and empress were to pass by. Although we were marched down to the street to greet them, our heads were to remain in the *Saikeirei* position so that the imperial couple would not see our faces and we could not see theirs. But I looked up anyway and saw the sweet face of our empress. No one else saw her. I had been told that anyone who looked would be blinded. My eyes, however, were not affected.

At the Seibi Academy, both girls and boys rehearsed the military code of honor and the marching routine daily. We paid respect to war heroes and the heroic war dead in every formal activity. On the eighth day of every month, the anniversary of the declaration of war, all of us marched to the Gokoku Shrine. The children whose fathers had died in action lined up in front. As the months and years passed, more and more children joined the line.

Those who had sacrificed their lives with special courage were called *Gunshin*—military saints. We were taught that the seven men chosen to act as undersea human torpedoes in the attack on Pearl Harbor were *Gunshins*. No one disputed their dedication, but I wondered why there had been only seven. The men had been allowed to bid farewell to their families; their mothers were said to have been proud to give their sons to their country.

We heard self-sacrifice in the war praised again and again until it made us all feel that dying for our country was most desirable. Although we were children, it gave us a sense of purpose to think that we might die for a cause, the most glorious of which was to die for the emperor. Nevertheless, I could never quite imagine becoming a human torpedo.

Our school days usually began with an assembly. The principal, who stood on a wooden platform a few feet off the ground, issued instructions and announcements. This was followed by rigorous calisthenics performed to lively music from a speaker. As the war progressed, building stamina became ever more important. The drill began to include long-distance running; carrying a partner on our back while marching was also added.

At midday, there was additional stamina building in which we stripped to our underpants so that we could give our bodies wet or dry washcloth rubs for 20 to 30 minutes. Winter and summer, we rubbed our bodies furiously outdoors. The teachers praised us when our skin glowed pink, proof of a job well done. For the older girls, it was embarrassing to stand unclothed on the same lawn with boys of the same age and male teachers. But this was war time.

Competitive sports were no less important. We had to reach certain goals in gymnastics, short- and long-distance running, hurdles, jumps, vaulting, turning bars, rope climbing, and throwing. Failure was not acceptable. One worked at it until the effort was adequate. The performances were closely timed, recorded, and rewarded. A red badge marked the greatest achievement, whereas blue and brown badges indicated less merit. I earned my red badge after performing 50 front wheels on the bar and nearly fainting from exhaustion. Homework, of course, was compulsory—dur-

ing school holidays, over the new year, and throughout the spring and summer.

By the winter and spring of my fourth-grade year, the mood of the country began to change drastically. The war losses were slowly coming to light. Japan might not win. My first real sense of grief came when the principal announced at our morning assembly that the troops stationed on Attu Island had committed ritual suicide rather than surrender. We sang for the fallen heroes:

To the sea
A willing corpse in water.
To the mountain
A willing corpse in the thickets.
Never turning back,
As we serve our Supreme Master.

To the mountains

The Tamura children attending the Seibi Academy walked to school together every day. Cousin Hideyuki and Cousin Kiyotsune were beginning to notice pretty girls in school, and I was starting to notice some of their athletic friends. I also admired Kiyotsune's gymnastic ability. He and I often waited for one another to walk home together, chatting about this and that. Once he began asking whom I really liked, calling out names and asking "yes" or "no." He saved his name for last. How sweet he was. I never got to tell him how much I admired him.

By 1945, B-29s flew all over Hiroshima prefecture on bombing missions. Tokyo was firebombed, and my Aunt Kimie was burned to death. In Hiroshima, shelters had been dug everywhere, and hurriedly built cement cisterns held water. We were drilled time and again on how to put out fires caused by incendiaries. Air raid sirens went off day and night. All of our clothes had labels sewn in with our names and addresses.

Kamikaze missions were being flown and hailed, but fuel for planes was running low. The draft age was lowered to 17, and children in high school were mobilized to do public labor. Finally, school-age children, in the sixth grade and under, were ordered out of the cities in a mass evacuation. The departure date for the children of the Seibi Academy was April 10. We would go to Kimita, a village in the mountains. That was frightening, but at least I would be with my best friend, Miyoshi.

For weeks, Mama worked at her sewing machine, whipping up my clothes, zabuton cushion, and futon. There was a weight limit for how much could be taken, so Mama kept checking the weight of the bundle she was preparing. We went over its contents in detail, but she saved a little pouch for last, which she placed in my hand. "This is part of us," she said. "Papa's nail clippings and my hair."

The Kimita elementary school was a spacious, two-story building. There wasn't much playground equipment—no factory-built jungle gym, but there was a wooden one, held together by ropes. The 40 Seibi Academy children formed their own groups in the school, but schooling itself became less and less important. In the end, we went to school only on rainy days. Otherwise, we worked outdoors.

The work was beyond our abilities, even after the stamina training at the academy. We dug up giant pine roots, built hearths, and tried to extract pine oil for airplane fuel. Some children wielded shovels; others carried rocks on their backs. Soon, food became scarce, and we were sent out in small groups to collect edible plants. We quickly learned which grasses were edible and tasty, and what mountainside had more curly fern buds.

Bathing was difficult at first. We would work all day and often go to bed dirty. Soon, everyone had lice. We became like a tribe of monkeys, constantly bending over to pick lice eggs out of a friend's hair. We were ashamed. Eventually, the Seibi group was divided up, and three or four would go to neighboring farmhouses for bathing, once or twice a week. The farmhouses lacked plumbing, and their wells seldom had pumps. We drew the water and built the fires to heat it. But we loved our bathing day, sitting with friends, checking the fire, and talking idly while waiting for a nice warm bath. It was almost like being back in Hiroshima.

Our letters home were censored by the teachers, who refused to mail anything that even hinted that we were unhappy. But we were. We were always hungry, and health-related problems, especially bed-wetting, grew worse among the children. Miyoshi and I almost got into a fight one morning when I woke up in a drenched futon after she had slept in my bedroll with me. My underwear was dry, but hers wasn't.

Miyoshi and I became convinced that our lives were more endangered by staying in the mountains and being hungry and lice-infested. I was having stomach problems and frequent toothaches. We secretly mailed an uncensored letter from the village post office saying that we wanted to come home. On the afternoon of August 4, our mothers came to get us. Miyoshi and I were like a pair of kittens, snuggling up to our liberators. Our mothers suggested we remain another day, just to rest, before going home. But Miyoshi and I were desperate to leave that place, so we all returned to Hiroshima August 5. As we went to our separate homes, Miyoshi and I promised to play together again soon.

Miyoshi and I were desperate to leave the mountains, so we returned to Hiroshima August 5.

A band of white light fell from the sky down to the trees.

A waterfall of light

The sun was shining in the garden on the morning of August 6, a Monday. A sense of gratitude welled up in me. I had escaped the countryside. No more mad dashes to the cold stream to wash up at dawn. No more heavy rocks to carry on my back. No more lice. No more going to bed amid the muffled sounds of weeping after the lights went out. No more gnawing hunger. I was a child again, held within the protective embrace of my mother and father.

Papa was already working at the harbor when I awakened. Hideyuki was at school. Mama soon went off to join her obligatory work detail, which was tearing down abandoned houses in the town center so they would not provide fuel in the event of an incendiary attack. If possible, she would try to slip away by lunch time so she could spend some time with me.

I lay back on my futon to read a paperback story about a Samurai duel that Hideyuki had loaned me. It was warm and the breeze was gentle. I wore nothing but underpants.

When the air raid warning siren went off at about 7:15, I turned on the radio. The voice seemed casual. Three enemy planes were heading toward the city. It hardly seemed worth worrying about. Hundreds, yes. But three? I remembered the first time planes had flown over in the middle of the night on their way to another city. Paralyzed with fear, I had clutched Mama, asking her, "Are we going to be hit?" She didn't know. But whatever happened, she had said, we would be together.

About 7:30, the radio announcer said the air raid warning had been canceled. The enemy planes had turned around. It was safe to go outside. I turned off the radio and went back to reading the Samurai story.

About 45 minutes later, an intense duel between rival swordsmen was about to take place in my book when a blinding flash swept across my eyes. In a fraction of a second, I looked out the window toward the garden as a huge band of white light fell from the sky down to the trees. Almost simultaneously, a thunderous explosion gripped the earth and shook it. I jumped up and braced myself next to a large pillar, as Mama had told me to do if a bomb hit nearby. Pieces of the heavy clay-tile roof fell about me. It was dark, as if the sun had disappeared in the thick black air and swirling wind. My mother had taught me to "live" if an air raid came—to flee fire, to seek the river. But now, there seemed to be no alternative to death as the earth heaved.

Suddenly, the wind and the motion stopped. The thick air began to clear. I was covered with soot and debris, but alive. The pillar had held, protecting me, giving me a breathing space. I tried to clear a larger space, but the tangled pieces were more than I could handle.

I cried out, and Aunt Fumiko's faint voice answered. "Where are you, Hideko?" She helped me get out. Although she was battered and scratched, her baby daughter was unhurt. After the flash, she had shielded the baby with her body.

After several loud yells, we found Grandmother Tamano and Aunt Kiyoko. They were bleeding and bruised and moving about aimlessly, as if in shock. Suddenly, we heard Fumiko's husband, Uncle Hisao, calling for help. He was sitting just outside the rear gate. His torn and blackened shirt was stained with blood and his eyes seemed hollow. He had been cut with flying glass and blood streamed from his throat, where a nail had been driven. He repeated over and over, "*Mo Dame da* . . . this is the end, this is the end." Aunt Fumiko sobbed as she picked out pieces of glass stuck in his skin.

My injuries were minor, a few cuts and bruises and a gashed right foot. I threw some clothes on and then tried to get everyone to leave as quickly as possible. Mama had told me, again and again, that in a bomb attack, fire would follow. But my grandmother and aunts and uncle lay under a tree in the garden and seemed not to hear me as they nursed their wounds. I wanted to cry. Mother had told me not to wait, to escape before the fire came.

Across the street, a medium-sized factory burst into flame and I knew that a wind shift could bring it to the remains of our house. I screamed, "Fire, fire, you've got to leave, you've got to get away!" No one responded. I could not wait. My mother must be obeyed. As I ran from the garden, I kept shouting, "Please leave!"

Running and walking away, I passed neighbors, disheveled and confused. They paid little attention to passers-by; no one recognized me. Their attention was fixed on getting out and looking for members of their own families. Houses had fallen in or were barely standing. Small flames were starting to spread like torches and the wind fanned them into fireballs. I heard cries of people asking for help. But I could respond only to my inner voice, my Mama saying, "Go to the water, child, stay close to the river, save yourself from fire."

As I headed toward the Ota River, limping and dragging my right foot, more injured people began moving the same way, in the general direction of the city's outer limits. Their clothes were torn and burned; some were naked or nearly so. I tried to look for someone I might know. There were no familiar faces.

Reaching the river, I saw a small group of adults and children, their hands clasped in prayer. An older man, perhaps the head of a

family, directed them to pray for the safety of others left behind. Explosions from the direction of the army base across the river rent the air every half minute or so. "They got the arsenals," someone said.

Suddenly, someone called my name. It was Noriko, a girl who lived next door. Her face and arms were very red. She had run from the schoolyard of her elementary school and now she was escaping the city with her family.

"Nori-chan, what happened to you?" I said.

"There was a flash and it burned me," Noriko answered.

"Yes, I saw the flash," I said. "It was like a white waterfall. Did your school get a direct hit?"

"It must have," she said.

As we talked, large blisters formed on Noriko's face and it became so swollen that I could scarcely recognize her any more. She said some of the children were in much worse shape than she, and the teachers were so injured that they could offer no help. She didn't know what happened to the other children or the teachers. I was grateful that there was a family I could walk with, even though Noriko was in such pain that she had to stop talking.

At the river, we saw a young schoolgirl slowly walking along, with pieces of skin hanging from her arms. Someone said she was trying to cool her burned skin, but as she rubbed water on it, it came off. She cried in pain.

The girl who could not assuage the pain with river water, Noriko's swollen face, the growing stream of burned and lacerated people, were but grains of sand on a vast beach. The horror was too great for comprehension.

The search

Thanks to a kindly driver who piled refugees into his truck, I made it to the countryside, where I was taken in by a farm family. The next morning, the farmer offered to bicycle into Hiroshima to seek out my family. He knew the Tamura home, one of the grandest in the city. When he returned at day's end, he said he had found my father at the burned-down house, but not my mother. He learned that Uncle Hisao had been patched up by a surgeon friend. Grandma Tamano and Aunt Kiyoko and Aunt Fumiko were bruised, but otherwise unhurt. Baby Kumiko was fine. We survivors of the Tamura household would meet at the home of a family friend in Kabe township.

The reunion in Kabe was not joyous. My mother was missing as was Hideyuki, Uncle Hisao and Aunt Fumiko's only son. Although I was an only child, Hideyuki had been like a brother. I adored him. But like a brother, he had terrified me at times.

Hideko attended the elite Seibi Military Academy in Hiroshima. This class photo was taken in early 1945, before the children were sent to the country so they would be safe from air raids. Hideko is in front, with her right leg outstretched. Her best friend, Miyoshi, is in the front row, third from the right.

The Tamuras had a bomb shelter deep in the garden, behind the trees and rocks. Hideyuki was obsessed with B-29s, which were systematically burning Japan's cities. To Hideyuki, the B-29 was a marvelous work of engineering. When the bombers flew over Hiroshima on their raids elsewhere, he would slip out of the shelter and go up to the roof of the house, where he would stare at them with binoculars. The rest of us would scream for him to come down, but his fascination with B-29s remained undampened. But now he was missing, and we had learned that a single B-29 with one bomb had caused the damage.

After the fires had burned out, we returned to Hiroshima to search for Hideyuki and my mother. Because the injured had fled in all directions and because the center of the city had disintegrated, there were no clues as to where to start. We began by checking out the "rescue" stations—schools, police yards, and temples—where the dying awaited medical care that did not exist.

In the police yard, my eyes were caught by a naked young woman, scantily covered by a thin blue cloth. Her petite body was curled up and she was breathing with great difficulty. A tag pinned to the cloth gave her name. She was a kindergarten teacher from my neighborhood. I tried to ask if she was all right. She whispered, "It is so hard. It is so hard." Her body began to shake and convulse and then she died. There were no marks on her, no cuts or blood or burns. I could not understand, and I was terrified.

At the next rescue station—a temple—the singed and blackened bodies lay on the floor unattended. The stench of rotting flesh filled the air. Soft moans were the only signs of life.

My father brought Mama's ashes home in his army handkerchief.

I called out Mama's name. It was difficult to think of her lying there, one of those disfigured, helpless people. But I could not bear thinking of Mama dying alone. Calling her name caused people to stir. They asked for water, but I had none. No one did.

At the third rescue station, I decided to sing Mama's favorite lullabies and melodies, which we used to sing together. I prayed, "Please God, let the wind carry the tune to my Mama." As I let the wind carry the melody of my soft humming, tears began to roll down my cheeks. But I wept quietly. I did not want the wind to carry the sound of my sobs to Mama, who I was sure was very hurt and dying. Otherwise, she would have returned to us by then.

I did not find Mama at the rescue stations. Uncle Hisao and Aunt Fumiko failed to find Hideyuki. We were told that my friend Miyoshi had died. However, Cousin Kiyotsune was found alive in the front yard of the Red Cross Hospital by his parents. He died a few days later.

We learned that most of Hideyuki's friends from the Hiroshima First Middle School were either dead or missing. Many had been crushed under the collapsed classrooms while others had been scorched in the melting heat.

Kiyotsune's mother told Aunt Fumiko, "You may be lucky. You didn't have to watch your son's end. You won't keep on seeing how he had to die." Tomoko, another of my second cousins and a playmate, never came home from school. She was never found. Her mother went into seclusion for the rest of her life.

One day, one of Hideyuki's classmates found Uncle Hisao and Aunt Fumiko. The classmate—Hara—had been among the few who escaped the collapsed school. He had fled the fires and joined a crowd moving toward Mt. Hijijama when he saw Hideyuki. Hideyuki was badly burned, naked to his calf girdle and army boots. He walked awkwardly, ghost-like, with his hands raised before him. He told Hara to go on although he could not.

Hara took Hisao and Fumiko to the spot where he last saw Hideyuki lying on the ground. The bodies had been removed. My aunt and uncle asked around if anyone had noticed their son lying there. People said there had been many bodies and the soldiers had hauled them away. No one knew where the bodies had been cremated.

In early September, we learned about Mama. A neighbor had been with her at the moment the bomb exploded. She and Mama were inside a concrete building near the center of the city. Because the neighbor had her two small children with her, and Mama had had a miscarriage in July, they had been excused from having to do the laborious outside work.

They were just inside the entranceway when the bomb exploded. Mama pulled her straw hat down over her ears and ran inside, just as the building fell in on her. The neighbor stayed in the entranceway and covered her children. She escaped before fire consumed the building.

My father went to the ruins of the building. There were several remains, so he could not tell which had been his wife. Then he stumbled upon an army canteen he had loaned her. Next to it were half-burnt, half-weathered remains.

He brought Mama's ashes home in his army handkerchief. I begged him to take me back to the place where he had found her. He refused. It was not a sight for me to remember, he said. To this day, I ask myself, "Was she crushed instantly?" I pray that she was.

By the river's banks

More than 23 years after the bombing, Papa traveled to Chicago to be at my wedding. Over the years, we had seldom spoken of the unspeakable past. But on that trip, he shared something with me that I had never heard before.

He had been at his post at the harbor, more than two miles away, and he had been well shielded by a sturdy building when the bomb burst. A few hours afterward, he had encountered a young American prisoner of war wandering in a daze. The young man looked no older than 17, with blond hair and blue eyes, and was naked except for his boxer shorts. He was surrounded by a crowd of injured civilians, mostly old men and women, carrying stones which they were about to use against him. My father, speaking as an army officer, reproached the otherwise ordinary and peaceful citizens. The young American, he said, was a prisoner under the protection of the military. He was not armed and he was obviously not about to harm anyone. They must not become killers themselves.

Later, Papa said, he learned that the bomb had killed 40 to 50 American prisoners of war who were located near the epicenter. As the officer in charge of the clearing task force, he was asked if the bodies of the prisoners should be cremated along with the Japanese. He told the workers that the American soldiers should be granted their own country's custom, which was to be buried.

By the banks of the Ota River, the Americans who perished in Hiroshima were buried. My father said he often wondered long after the war about the handsome young man with the fearful eyes, and about his parents. They must have grieved for their son, who almost surely never came home. As he spoke, there were tears in his eyes. ■

"Always" the target?

By ARJUN MAKHIJANI

While U.S. bomb scientists were racing against Germany, military planners were looking toward the Pacific.

On April 23, 1945, Gen. Leslie R. Groves, director of the Manhattan Project, wrote a memo to Henry L. Stimson, secretary of war. It contained a puzzling phrase, which I have italicized:

"Our previous hopes that an implosion type of bomb might be developed in the late spring of 1945 have now been dissipated by scientific difficulties. . . .

"While our plan of operations is based on the more certain, more powerful, gun type bomb, it also provides for the use of the implosion type bombs as soon as they become available. *The target is and was always expected to be Japan.* A composite group of the 20th Air Force has been organized and specially trained and equipped."[1]

By the time the memo was written, it was clear to everyone connected with the atomic bomb project that Germany would not be the target. The Third Reich would collapse long before the first bombs were ready for use. If the new weapon was to be used at all in World War II, it would be against Japan.

But had Japan "always" been the target, as Groves implied? If so, that fact suggests a terrible irony that has been little noted in the decades-long debate over the use of the bomb. From August 1939, when Albert Einstein alerted President Roosevelt to the possibility that atomic bombs could be built, to late 1944, when it became entirely apparent that Germany was not an atomic threat, the focus of U.S. bomb makers was Germany.

Émigré scientists from Europe especially—Leo Szilard (who first conceived the idea of an atomic bomb), Enrico Fermi, Hans Bethe, Victor Weisskopf, Eugene Wigner, James Franck, Niels Bohr and the like— played pivotal roles in the Manhattan Project. To a man, they—along with their American and British colleagues—got involved for one overarching reason: Germany had first-rate scientists who presumably understood the destructive possibilities of nuclear fission. The United States had to develop an atomic bomb before the Ger-

UPI/BETTMANN

Two months after the first atomic test in July 1945, military director Leslie Groves and scientific director J. Robert Oppenheimer revisit the test site.

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"We thought the Germans would be the target for the atomic bomb."

mans did. Such weapons in the hands of Hitler would be the ultimate catastrophe for the world.

Joseph Rotblat, a Polish scientist before the war and a founder of the Pugwash movement after the war, told me last February that "there was never any idea [among scientists] that [the bomb] would be used against Japan. We never worried that the Japanese would have the bomb. We always worried what [Werner] Heisenberg and other German scientists were doing. All of our concentration was on Germany."

Surviving Manhattan Project scientists continue to believe that the atomic bombs were used on Hiroshima and Nagasaki, rather than on German targets, merely because they were not ready in time. But that may not be the whole story. There is evidence—albeit fragmentary—that as early as May 1943, high-level planners assumed that Japanese rather than German military forces would be the likely target for first-use of the new weapon. That was long before anyone could reasonably predict when the war in Europe might end or when atomic bombs might be ready for use.

The first targeting discussion—insofar as can be determined from declassified documents and Manhattan Project histories—seems to have occurred during a meeting of the high-level Military Policy Committee on May 5, 1943.[2] The discussion that day ranged over a variety of topics—personnel issues, technical problems, commissioning a study on radioactive poisons, and even a "story to be allowed to leak out on the Los Alamos project to reduce the curiosity of the local population."

According to Groves's summary of the meeting:

"The point of use of the first bomb was discussed and the general view appeared to be that its best point of use would be on a Japanese fleet concentration in the Harbor of Truk [in the Pacific, north of New Guinea]. General Styer suggested Tokio but it was pointed out that the bomb should be used where, if it failed to go off, it would land in water of sufficient depth to prevent easy salvage. The Japanese were selected as they would not be so apt to secure knowledge from it as would the Germans."[3]

The discussion was surely a blue-sky exercise. The Manhattan Project was still at an early stage, D-Day was more than a year away, the war in the Pacific was not yet going well for the United States, and no one could have predicted how important the Japanese fleet or Truk might be by the time the bomb was ready.

Nevertheless, the discussion suggests a line of thought that would have astonished Manhattan Project scientists, if they had been privy to it. In fact, it surprises them today, although the existence of the memo has been revealed before. (See, for example, page 253 of *The New World*, an official history of the Atomic Energy Commission by Richard G. Hewlett and Oscar E. Anderson Jr., published in 1962, which mentions it.)

Hans Bethe, who headed the Theoretical Division at Los Alamos, was astonished when I discussed the memo with him in February: "I am amazed both by the conclusion not to use [the bomb] on Germany and secondly by their reasons [for targeting the Japanese fleet]. We [the scientists] had no idea of such a decision. We were under the impression that Germany was the first target until the German surrender. That was my belief. Obviously, it was wrong."

Glenn Seaborg, who headed the team that first isolated plutonium, concurs. In an interview with me in February, he said: "So far as I recall, right up until the time the Germans surrendered in the spring of 1945, we thought that the Germans would be the target for the atomic bomb. As their demise became more and more predictable, perhaps we somewhat drew away from that feeling. But certainly we thought in 1944 that Germany would be the target."

David Hawkins, who was a special assistant to J. Robert Oppenheimer (the scientific director of the Los Alamos Laboratory) and the historian for the Los Alamos effort, agreed. When I asked him in February about the memo, he said that the scientists had no idea that Germany had been discussed and apparently rejected as a potential first-use target as early as May 1943. Indeed, Hawkins and others I interviewed—including John A. Simpson, a group leader in the Chicago Metallurgical Laboratory and a founder of the *Bulletin*—do not recall targeting discussions among the scientists taking place until well into 1945.

Rotblat seems to have been the exception to that. He left the Manhattan Project in December 1944, after it became clear to him that Germany was no longer a nuclear threat. But once he announced his decision to leave, he was not permitted to talk about it with his colleagues.

The bomber of choice

In contrast to the specific suggestion of targeting the Japanese fleet at Truk, possible use of the bomb against Germany seems to have been only vaguely addressed at high levels. A Military Policy Committee status report of August 21, 1943, suggests that if the war became "unduly" long, the Germans might be able to produce "a usable bomb" before the United States. In that event, the committee concluded that it might "be necessary for us to

stand the first punishing blows [of German atom bombs] before we are in a position to destroy the enemy."[4] Meanwhile, practical preparations continued for use of the bomb in the Pacific theater.

In the latter half of 1943, Navy Capt. William S. Parsons, who headed the project's ordnance group, chose the B-29 as the bomber the United States would use, if it could be appropriately modified.[5] According to Hewlett and Anderson, the choice of the B-29 indicated that Japan was already the target. "Had Germany been the primary target, the choice would hardly have fallen on an aircraft never intended for the European theater."[6]

That conclusion is supported, at least indirectly, by the technical facts. British Lancasters could have been modified for the atom bomb. The four-engine Lancaster had a normal payload of 14,000 pounds, but some had been modified to carry the "Grand Slam"—at 22,000 pounds, the heaviest bomb produced in the war. The chief technical advantage the B-29 had over the Lancaster was its great range—3–4,000 miles. That made it the only bomber suitable for use in the Pacific.[7]

Another advantage of the B-29 was its made-in-USA label. In a March 1944 meeting between Groves and Gen. Henry H. "Hap" Arnold, commander of the Army Air Force, Groves said the first choice was the B-29, but the Lancaster had to be considered as a backup. That "displeased Arnold, who stated emphatically that an American-made airplane should carry the bombs."[8]

In any event, that Japan would be the target of the atom bomb, if it were used at all, was affirmed in September 1944, when President Roosevelt and British Prime Minister Churchill met at Roosevelt's Hyde Park home. A summary of the meeting makes no mention of the possible use of atomic bombs against Germany, but it says that when the bomb was ready "it might perhaps, after mature consideration, be used against the Japanese, who should be warned that this bombardment will be repeated until they surrender."[9]

Momentum builds

The Military Policy Committee targeting discussion of May 5, 1943, had nothing to do with an estimate of when the war against Germany might end. In the spring of 1943, no one knew when that might be. Moreover, the technical problems that eventually delayed bomb production into the summer of 1945 had not yet emerged. In fact, a report of the committee, dated August 21, 1943, suggested that a fission weapon might be available by the fall of 1944 or by January 1, 1945.[10]

That schedule would have been compatible with the targeting of Germany. But the available documentation suggests that there were no discussions, much less plans, for use of the bomb against Germany. Given the fact that losses of Allied troops were expected to be heavy during and after D-Day, one might expect to find evidence that contingency plans to use the bomb in the fall of 1944 had been made. But there is no evidence of that, either. Rather, what evidence there is—albeit sketchy—suggests that there was simply an automatic assumption at an early stage that Japanese forces would be the target.

That assumption contrasts sharply with rationales for the bomb project. For example, in March 1942, Vannevar Bush, President Roosevelt's chief science adviser, said in a memo to the president that the "successful use [of atomic bombs] would be very important and might be determining in the war effort. It is also true that if the enemy arrived at the results first it would be an exceedingly serious matter."[11]

The "enemy" was Germany. The presumed German bomb effort drove the Manhattan Project, giving it an urgency unmatched by any other wartime project. In 1942, a host of war-related projects were in fierce competition for industrial and intellectual resources. Nevertheless, in June of that year, Roosevelt endorsed a high priority for the still-speculative bomb effort. In September, when Groves took over the Manhattan Project, he obtained the highest priority—AAA—for use whenever a slightly lower priority, AA-3, was deemed insufficient. Eventually, Groves's project grew so large that during some periods it "was using more AAA ratings than the combined total for all other Army and non-Army programs."[12]

As early as 1939, fear of a German bomb prompted the United States to begin its own research program. By late 1942, Roosevelt and his top scientific advisers had decided to pro-

MIKE MOORE

In a September 1994 reunion, members of the 509th Composite Group—and their spouses—visited the University of Chicago, where the first self-sustaining nuclear reaction took place in December 1942. Here, the 509th—the outfit that dropped the bombs—inspects Henry Moore's "Nuclear Energy."

Groves kept the bomb scientists isolated from any discussion of how their work would be used.

ceed at top speed; that might insure that atom bombs would be produced in time to be a "determining" factor in the outcome of the war. But in late 1944, when a U.S. intelligence-gathering mission code-named "Alsos" revealed that the German bomb program had made virtually no progress, that fact made no difference. By then, the all-out U.S. effort had created its own momentum independent of anything Germany was or was not doing.

Fear of a German bomb got the U.S. project going; but once it was under way—at a resource-straining AAA priority level—officials connected with it were compelled to demonstrate that it would have a decisive effect on the outcome of the war. During 1944, for instance, congressional demands for an investigation of the mysterious project that commanded so much in the way of resources grew. Jack Madigan, an official in the War Department, said in a status report: "If the project succeeds, there won't be any [congressional] investigation. If it doesn't, they won't investigate anything else."[13]

James F. Byrnes, Roosevelt's director of the Office of War Mobilization, was acutely aware of the potential for intense political problems if atom bombs were not produced and used in the war. On March 3, 1945, he wrote to Roosevelt, saying that "if the project proves a failure, it will then be subjected to relentless investigation and criticism."[14]

Shortly thereafter, Roosevelt died and Byrnes became President Truman's secretary of state. The new president was surely attuned to Byrnes's concerns. As a senator in 1944, he had wanted to investigate the project, which seemed to produce nothing—but at great expense. Upon being denied permission to do so, he wrote Secretary of War Henry L. Stimson that the "responsibility . . . for any waste or improper action which might otherwise be avoided [by a senatorial inquiry] rests squarely on the War Department."[15]

Truman appointed Byrnes as his representative to the Interim Committee, which first met after Germany surrendered. The committee was established to provide recommendations on a wide range of nuclear energy issues; inevitably, that included a consideration of how the bomb would be used against Japan.

David Robertson, in a recent biography of Byrnes, says that Byrnes "had a three-part agenda for atomic power" as a member of the Interim Committee. First, he was "against sharing of any atomic research with the Soviet Union." Second, he wanted the atomic bomb used "as quickly as possible in order to 'show results.'" (It was Byrnes who urged that the Interim Committee recommend that the bombs be used "on a war plant surrounded by workers' homes.") Finally, Byrnes wanted "the bomb used without warning."[16]

Questions

Time has not stilled the controversies surrounding the decision to bomb Hiroshima and Nagasaki, even while Japanese diplomats were quietly exploring a face-saving way to surrender. In the past five decades, millions of words have been written to explain the bombings.

To most Americans—especially veterans—the use of the bombs was a cut-and-dried matter. They were dropped to end the war quickly and thus save American lives.

In contrast, some historians argue that the Manhattan Project created its own logic leading to the use of the bombs. It was simply not reasonable to believe that after spending so much money and swallowing up so much of the nation's scarce wartime resources that such a decisive new weapon would be put on the shelf.

In recent years, many historians have argued that the use of the bombs had little to do with World War II. Rather, it was part of a *Realpolitik* campaign to intimidate the Soviets and make them more tractable in the post-war world.

Meanwhile, many have noted the obvious: High-level decision makers had already crossed the moral threshold regarding the deliberate bombing of civilians in February 1945, when the United States joined the British in the "terror bombing" of Dresden (Churchill's phrase).[17] About 40,000 people were killed in Dresden. And in March the United States began its terror raids against Japan, with the fire bombing of Tokyo.

According to various post-war surveys, hundreds of thousands of civilians were killed in Germany and Japan by air raids—before the atomic bombs were dropped. The use of atom bombs merely increased the terror, in that a single bomber, rather than hundreds or thousands, could now destroy a whole city.

Finally, it seems clear that the May 5, 1943, memo suggests that a form of nuclear deterrence was at work. The Germans were thought to have an active nuclear bomb program; therefore, the Military Policy Committee was reluctant to use the first U.S. bomb against German forces. If it had been used against a German target—and if it had been a dud—the Germans might have been more likely to recover it and "to secure knowledge from it."

All such explanations—and more—find historical support in documents relating to the Manhattan Project and World War II. But nothing in the historical record can answer these questions: How many scientists—if any—would have left the project if they had

known in 1943 that Japan might have been the target of first use? How many scientists simply would have quit in 1943 and 1944, Rotblat-style, if they had known—if Groves's words of April 1945 can be taken at face value—that the target "was always expected to be Japan"?

In the early days of the Manhattan Project, U.S. and British scientists believed they were in a desperate winner-take-all race with German scientists. That was especially true of the émigré scientists who came to the Manhattan Project. They had experienced Nazism first-hand, and their fear and loathing of Hitler was intense. They were convinced that German science was fully capable of producing a terrible new weapon that Hitler would use to enslave the world.

Over the years, Groves used that fear of a German bomb to drive his team onward. By late 1944 and 1945, however, the Manhattan Project had gained such momentum that it was unstoppable, despite the collapse of Germany. There is also evidence that by then most of the scientists working on the project wanted to see it through—to learn if the "gadget" would actually work. (Rotblat, in his August 1985 *Bulletin* article, called it "simple curiosity—the strong urge to find out whether the theoretical calculations and predictions would come true.")

By the fall of 1944, a U.S. effort that began because of the fear of a German nuclear weapons program had been transformed in a way that virtually guaranteed that nuclear weapons would be used as a tool of immense military superiority against a non-nuclear power, to accomplish a variety of goals.

To be sure, a number of scientists—but still a minority of the Manhattan Project team—were concerned about the moral implications of the bomb and *how* it might be used. Nevertheless, by the end of 1944, when Rotblat quit the project, the majority of scientists "were quite content to leave it to others to decide how their work would be used."[18]

But in 1943, the dynamics of the Manhattan Project were far different. The outcome of the war was far from certain and fear of a German victory was great. In the summer of 1943, Harold Urey, a Nobel Prize winner and one of the key members of the project, even recommended that Groves warn the American people of the possibility of an atomic attack, a suggestion the general ignored.[19]

Through his policy of strict compartmentalization of information, Gen. Groves kept bomb scientists isolated from any discussion of "how their work would be used." However, if the scientists had known early in their work that Japanese forces rather than German forces might be the first target, would there have been defections? If so, could an atomic bomb have been designed and produced in time to be used in the war?

Fifty years later, such if-only-they-had-known speculation is merely an intellectual exercise dealing with a host of unknowable factors. But it does raise an essential philosophical and practical point regarding secrecy and the responsibility of scientists—an old question that is nonetheless as relevant today as it was 50 years ago:

If scientists do not have the minimum information needed to participate openly and democratically in deciding how the weapons of mass destruction they make will be used, should they be involved in making them? ■

1. Leslie R. Groves, "Memorandum to the Secretary of War," April 23, 1945, Records of the Manhattan Engineer District, 1942-1948, Record Group 77, National Archives, Washington, D.C.

2. At the meeting: Vannevar Bush and James B. Conant, President Roosevelt's two top civilian advisers on the bomb project, and Rear Adm. William R. Purnell, Maj. Gen. Wilhelm D. Styer, and Groves.

3. Leslie R. Groves, Memorandum, "Military Policy Committee," Records of the Manhattan Engineer District, 1942–1948, Record Group 77, National Archives, Washington, D.C.

4. Military Policy Committee, "Report of August 21, 1945, On Present Status and Future Program on Atomic Fission Bombs," Records of the Manhattan Engineer District, 1942–1948, Record Group 77, National Archives, Washington, D.C.

5. Lee Bowen, *Project Silverplate, 1943–1946*, vol. 1 of *A History of the Air Force Atomic Energy Program 1943–1953*, (Air Force Historical Division, 1959); and Richard Hewlett and Oscar Anderson, *The New World*, (Berkeley, Calif.: University of California Press, 1990), p. 253.

6. Hewlett and Anderson, *The New World*, p. 253

7. Technical data on the Lancaster and B-29 bombers provided by Robert S. Norris, Natural Resources Defense Council, Washington, D.C.

8. Vincent Jones, *Manhattan: The Army and the Atomic Bomb* (Center of Military History, United States Army, Washington, D.C., 1985), p. 520.

9. Martin Sherwin, *A World Destroyed* (New York, N.Y.: Vintage Books, 1987), p. 284.

10. Military Policy Committee, "Report of August 21."

11. Vannevar Bush, "Report to the President: Status of Tubealloy Development," March 9, 1942, Records of the Office of Scientific Research and Development, Record Group 227, National Archives, Washington, D.C.

12. Jones, *Manhattan*, p. 82.

13. As quoted in Leslie R. Groves, *Now It Can Be Told* (New York, N.Y.: Harper & Brothers, 1962), p. 360.

14. James F. Byrnes, "Memorandum for the President," March 3, 1945, Modern Military Branch, National Archives, Washington, D.C.

15. Harry S. Truman to Henry L. Stimson, March 10, 1944, Modern Military Branch, National Archives, Washington, D.C.

16. David Robertson, *Sly and Able* (New York, N.Y.: W.W. Norton, 1994), p. 410.

17. Noble Frankland and Charles Webster, *The Strategic Air Offensive Against Germany I V*, (London, England: Her Majesty's Stationery Office, 1961), p. 112.

18. Joseph Rotblat, "Leaving the Bomb Project," *Bulletin of the Atomic Scientists*, August 1985, p. 18.

19. Peter Wyden, *Day One* (New York, N.Y.: Simon and Schuster, 1984), p. 106.

Smithsonian suffers Legionnaires' disease

By STANLEY GOLDBERG

For the fiftieth anniversary of the atom bombing of Japan, the museum wanted to mount an educational exhibit—others expected an uncritical celebration of the end of the war.

Fifty years ago, I was an 11-year-old paperboy for the afternoon *Cleveland Press*. On the afternoon of August 6, 1945, the bundled papers waiting for me had a banner headline saying: "Atom Bomb Hits Japan." The second line said: "Blast Force Equals 2000 Blockbusters." Amazing. Although the news was momentous, the readers of the *Cleveland Press*—at least the readers on my route—had to wait for it. I read every word of the several articles on this new thing called an atomic bomb before delivering the papers.

In the coming years, I continued to read everything I could on the atomic bomb—as well as on the promise of nuclear energy and the field of nuclear physics. In a way, that was the start of my professional career as a historian of science. And that interest—an obsession, really—eventually led me to play a role in the recent *Enola Gay*-Smithsonian Institution fiasco—a long-running and ultimately dispiriting morality play in three acts.

Act One: An "impressive piece of work"

In the fall of 1984, Roger Kennedy, the director of the Smithsonian's National Museum of American History asked me to meet with him and some of the museum's curators to discuss the fact that nowhere in the museum was there a mention of two of the defining moments of the twentieth century: the obliteration of Hiroshima and Nagasaki by atomic bombs.

There was enthusiasm around the table that day for mounting such an exhibit in time for the fortieth anniversary of the bombing. Kennedy asked me to identify artifacts, produce a "script," and oversee the installation. In museum-speak, a script is the blueprint that specifies how an exhibition will be laid out, and what artifacts, photos, and documents it will present. The script also contains the language that will be in the "labels."

The 1985 exhibit—composed of Hiroshima- and Nagasaki-type bomb casings as well as photos and artifacts in two display cases—sketchily described both the Manhattan Project and the destructive power of the bombs. Because I was worried about the emotional impact the exhibit might have on unprepared visitors, I drained the emotion from the labels. Nevertheless, the guiding principle of the exhibit was simple, even simple-minded. I wanted to make it clear that nuclear devastation was not merely an abstract topic discussed by Cold War theorists. Nuclear weapons—and their effects—were real. Among the artifacts were roof tiles that had bubbled from the heat. One of the photos showed a man whose head was badly flash-burned, except where his hat had offered some protection.

The exhibit was well received. Scheduled to be on the floor only during the month of August, it was retained through November. Kennedy asked me to undertake a year-long study as to how a large and permanent exhibit could be handled. I plunged in, but a year later, the museum's administration had lost its enthusiasm. Although the Smithsonian gets public money, many of its activities must be funded privately, and private funding for an atomic bomb exhibit had not been forthcoming. That was no great surprise. When it came to fundraising for not-very-popular projects, curators at the museum sometimes spoke of the museum administration as having "a whim of iron."

To this day, the Smithsonian's National Museum of American History has no separate display on the Manhattan Project or the use of atomic bombs in war. It does, however, have a small and spare atomic display tucked into a larger exhibit on "Science and American Life."

Given the failure of the American History Museum to pursue the proj-

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ect, I was surprised and pleased in 1991 when I learned that the Smithsonian's National Air and Space Museum would install a major exhibit on the end of World War II, which would be in place by May 1995.

The exhibit—called "The Last Act: The Atomic Bomb and the End of World War II"—would feature the front portion of the *Enola Gay* fuselage, and it would explore the role played by the atomic bomb in bringing the war to an end. I was asked, along with nine others, to serve on the Exhibit Advisory Board. The first draft of the exhibit script, put together by the museum's curators and distributed to the advisory board in January 1994, was a heavyweight—upwards of 750 pages of text and illustrative material.

The board met with the curators in February to go over the script. Our role was to review and suggest. The content of the final exhibit, we believed then, would be in the hands of the curators.

Rather than retelling the whole story of the Pacific war, which would not have been possible in the space allotted, the curators linked the atomic bombings to the evolution of the strategic bombing campaign of the XXI Bombing Command of the 20th Air Force, Gen. Curtis LeMay's outfit that was systematically incinerating one Japanese city after another. Rather than having to use hundreds of planes in a raid, the Air Force could now achieve the same effect with one plane. The theme did not originate with the curators; it had been explored widely and thoroughly over the years. See, for instance, Michael S. Sherry's definitive *The Rise of American Air Power*, published in 1987.

The flow of the script was logical. After some unremarkable references to the start of the war and the attack on Pearl Harbor, the exhibit began with V-E Day and concentrated on the battles for Iwo Jima and Okinawa. Together, these two campaigns were almost as costly in American casualties as the first three years of the Pacific war.

The decision to use the bomb—and how to use it—was a complicated one, but the curators had done a fine job of making the subject accessible to a general audience. That was no easy task. The story line then moved to an exploration of the "miracle" of the design and production of the B-29. This was followed by a section on the training of the crews chosen to deliver the bombs—the 509th Composite Group—and the construction of the 509th facilities on the island of Tinian in the Marianas.

After describing—in words, photos, and artifacts—the scene at and near ground zero in Hiroshima and Nagasaki, the exhibit ended with a sec-

President Harry S. Truman, shown here in 1961 in front of the Truman Library in Independence, Missouri, made the decision to use atom bombs against Japanese cities. After the war, he expressed no regrets publicly, saying in his *Memoirs* that "we had labored to construct a weapon of such overpowering force that the enemy could be forced to yield swiftly once we could resort to it." Privately, Truman may have experienced second thoughts after Nagasaki. According to Secretary of Commerce Henry Wallace, Truman told members of his Cabinet that he had issued orders that no more atom bombs be dropped. "The thought of wiping out another 100,000 people was too horrible," Wallace quoted Truman as saying.

MIKE MOORE

NATIONAL ARCHIVES

An aid station established at the west end of the Miyuki Bridge, 2.3 kilometers from ground zero, Hiroshima. The photo was taken by Yoshito Matsushige, a photographer, at about 9:15 on the morning of August 6, 1945. The photo was slated to be in the exhibit.

tion on the legacy of the atomic bomb: An abrupt halt to the war, and a fierce and competitive nuclear arms race between the United States and the Soviet Union.

The advisory committee represented a wide range of disciplines and professional expertise. (See the list on the facing page.) But there was unanimous agreement at the advisory board meeting that the initial approach of the curators was sound. Although the curators' plan was not the only one they could have used, they had done a careful and professional job. The task now at hand was one of fine tuning.

This is not to say that members of the advisory board had no criticisms. Some of us believed the script overemphasized the role that international politics played in the decision to use the bomb—the argument that the bombs represented the first shots in the coming Cold War. In fact, there were at least four other overarching reasons for using the bomb—all important, but some of which had gotten short shrift in the script:

■ The momentum of the Manhattan Project itself, the biggest single scientific and industrial enterprise of the war.

■ Domestic politics, which guaranteed that the Truman administration would pay a fearful price if the American people ever learned that a superweapon had been developed but not used.

■ Personal ambition, particularly Gen. Leslie Groves's conviction that he was playing *the* pivotal role in ending the war, and J. Robert Oppenheimer's obsessive concern with the kind of immortality the bomb would bring him.

■ Humanitarian concerns that the war should be ended quickly, not only for the sake of Americans but for the Japanese. Although peace factions within the Japanese government were exploring ways to end the war and they might have prevailed, Japanese militarists were still running the show in the summer of 1945. Meanwhile, the fire-bomb raids continued. General LeMay believed that his men would be able to burn down every Japanese city of consequence by October. Had the war continued that long, the continued firebombing would almost surely have produced hundreds of thousands of civilian casualties.

All of these concerns were a matter of emphasis. They could have been addressed by a little refining. There was nothing odd or unexpected or sinister about that. One would never expect that a first-draft script of a complex topic would not raise questions in a peer-review process. Some labels had to be reworded, expanded, shortened. But the consensus of the advisory board was clear: The exhibit would inform, challenge, and commemorate.

As Air Force Historian Richard Hallion, a member of the board, put it in his written remarks: "Overall, this is a most impressive piece of work, comprehensive and dramatic, obviously based upon a great deal of sound research, primary and secondary."

Act Two: Everyone's unhappy

Shortly after the advisory board meeting, the script was leaked to the Air Force Association. When I heard through the grapevine that the association was unhappy with it because of its alleged pro-Japanese and anti-American and anti-nuclear bias, I was neither surprised nor alarmed. The curators had presented a solid script rooted in the latest historical scholarship.

Besides, it was common knowledge that the Air Force Association believed that the Air and Space Museum should be devoted exclusively to celebrating the accomplishments of U.S. air power and space ventures. But when the budding controversy was picked up by the news media, and when the American Legion joined in, I began to realize that the exhibit was in for a tough go.

For starters, there was simply no agreement on the meaning of "history." In writing history, professional historians follow a process analogous to the methods identified with science. They develop ideas about how and why something happened and then they test those ideas against whatever documentary evidence they can locate. Finally, they make their data and conclusions available to other historians to be confirmed and refined—or ripped and shredded.

But journalists sometimes follow a different process. The arcana of scholarly methodology would not only bore readers and viewers, it would drive them away. Readers and viewers love controversy and conflict, and journalists devote great energy and talent to reporting it. Once the Air Force Association and the American Legion got into the act, the ingredients for a fine drama were in place.

On one side were some of the vets who actually fought the war, or their spiritual descendants. On the other side were academic curators and historians, often described as "revisionist," and sometimes seen as picky and pedantic.

In late September, Ken Ringle, a *Washington Post* reporter, summed up the controversy admirably, without quite realizing it. In an article in the *Post*, he contrasted the documentary evidence used by historians with the memories of veterans who served in the Pacific. Documentary evidence was "old history, a scholarly abstraction composed of archival records, argumentative books, and . . . fading images on black and white film." Living history came from veterans.

One of the vets Ringle quoted was Grayford C. Payne, who had been a prisoner of war in Japan from 1942 to 1945. With tears in his eyes, Payne said he was sure that the atomic bombs had saved his life. If an invasion of the home islands had taken place, he and his buddies would have been executed.

Powerful flesh-and-blood stuff; documents compete poorly with human interest. Ringle's piece seemed to imply that the opinions of the veterans he interviewed were a more accurate guide to what happened in the war than histories of the war based on archival materials. Subsequent editorials in the *Post* gave explicit support to that view.

In an August 7 op-ed piece in the *Post*, Martin Harwit, director of the Air and Space Museum, defended the original script as well as his efforts to placate critics. Nevertheless, he wrote, "We have found no way to exhibit the *Enola Gay* and satisfy everyone."

A week later, the *Post* responded editorially, suggesting that Harwit and the curators assumed their critics had less "intellectual sophistication." This, said the *Post*, "naturally rankles with veterans and other groups that offered detailed and substantive criticisms of the initial plan which they said was emotionally rigged to create an anti-nuclear perspective and to present Japan overwhelmingly as a victim country fighting only to preserve its 'culture.'"

The *Post* charged that the curatorial failings reflected an "inability to perceive that political opinions are embedded in the exhibit or to identify them as such—opinions—rather than as universal, 'objective' assumptions all thinking people must necessarily share. This confusion is increasingly common in academia and owes much to the fashionable and wrong academic notion that objectivity is unattainable anyway and that all presentations of complex issues must be politically tendentious."

The editorial made me wonder if any member of the *Post* staff had actually read the script. The personal experiences of individuals *are* important to historians. But they are just some of the pieces in a puzzle that has many different kinds of pieces. That's a basic point, but one that seemed to elude most journalistic observers.

By August 1994, it was clear that the Air Force Association and the American Legion didn't have a better hand than Harwit and the curators—but they had the *upper* hand. They were adept at working with the press and putting their particular flag-waving, human-interest spin on the story.

As early as May, the Air and Space Museum curators had begun negotiating the content of the exhibit and the wording of the labels directly with representatives of the Air Force Association and the American Legion. The advisory board, which had met just once—in February—was simply out of the picture.

From the start, the Air Force Association and the American Legion exploited early lapses in judgment by the curators. These were lapses that the advisory board had noted at its February meeting, and which surely would have been fixed in the normal course of events without much hassle. For example, the board objected to a first-draft label that ended with the following passage:

"For Americans this [Pacific] war was fundamentally different than the one waged against Germany and Italy—it was a war of vengeance. For most Japanese, it was a war to defend their unique culture against Western imperialism."

To critics of the proposed exhibit, that passage was the smoking gun, and it was widely disseminated to the press. The *Post* editorial I quoted a moment ago referred to it, as did countless newspapers. But the passage had been ripped from its context. The full label said:

"In 1931 the Japanese Army occupied Manchuria; six years later it invaded the rest of China. From 1937 to 1945, the Japanese Empire would be constantly at war.

"Japanese expansionism was marked by naked aggression and extreme brutality. The slaughter of tens of thousands of Chinese in Nanking in 1937 shocked the world. Atrocities by Japanese troops included brutal mistreatment of civilians, forced laborers and prisoners of war, and biological experiments on human victims.

"In December 1941, Japan attacked U.S. bases at Pearl Harbor, Hawaii, and launched other surprise assaults against Allied territories in the Pacific. Thus began a wider conflict marked by extreme bitterness. For most Americans, this war was fundamentally different than the one waged against Germany and Italy—it was a war of vengeance. For most Japanese, it was a war to defend their unique culture against Western imperialism. As the war approached its

The Enola Gay Exhibit Advisory Board

Edwin Bears, chief historian, National Park Service
Barton Bernstein, history department, Stanford University
Victor Bond, medical department, Brookhaven National Laboratory
Stanley Goldberg, the author
Richard Hallion, Center for Air Force History
Akira Iriye, history department, Harvard University
Edward T. Linenthal, religious studies department, University of Wisconsin–Oshkosh
Richard Rhodes, author of *The Making of the Atomic Bomb*
Martin Sherwin, director of The John Sloane Dickey Center at Dartmouth College, and author of *A World Destroyed: The Atomic Bomb and the Grand Alliance*
Herman Wolk, Center for Air Force History

end in 1945, it appeared to both sides that it was a fight to the finish."

That is solid history, not an absurdity. The label wasn't wrong; it just needed fine tuning. The contempt that both countries had toward each other during the war has been well documented, for example by John Dower in *War Without Mercy*. That contempt was fully explored in the original script. Nevertheless, the advisory board suggested that the "imperialism" paragraph be recast to emphasize the role of Japanese militarism.

The meaning of many other labels was badly distorted by the critics. Air Force Historian Hallion, who had found the first-draft script so praiseworthy at the advisory board meeting, decided later, after the initial attacks by the Air Force Association, that the curators had "resisted addressing basic deficiencies of the exhibit even during subsequent 'grudging' revisions." He told *Post* reporter Ringle that Harwit and the curators insisted on focusing on the devastation of Hiroshima and Nagasaki and resisted portraying Japanese aggression and atrocities.

Hallion also told a *Washington Times* reporter, Josh Young, that "the information [in the exhibit] is biased. It doesn't permit the visitor to reach an informed conclusion. The visitor comes away with the impression that the bomb should not have been dropped. It doesn't take into account the severity of the war or the complexities of the decision."

Some of the artifacts that were to be displayed in the exhibit also unhinged critics. The exhibit that I helped put together for the Smithsonian's National Museum of American History in 1985 went to great lengths to avoid shocking the viewers, but the proposed 1995 Air and Space Museum exhibit was confrontative in its choice of photos and artifacts.

Among the more unsettling artifacts, loaned to the Smithsonian by the Hiroshima Peace Memorial Exhibit, were items belonging to a group of schoolmates: a student's lunch box containing the carbonized remains of sweet peas and polished rice; a water bottle; and a wooden clog revealing, by blast-induced darkening, the outline of a foot. Photos depicted the devastation of the city and badly burned people.

Critics charged that such displays were designed to evoke sympathy for the Japanese. The exhibit, they said, should contain artifacts and photos depicting Japanese atrocities. In fact, the curators were simply trying to show the effects of an atomic bomb. Those effects were real, and they are hard to face up to. The Hiroshima bomb detonated over a hospital, not a tank factory or an ordnance works. Nearby schools were in session, filled not with soldiers but with children. Two bombs killed upwards of 200,000 people immediately and over the following weeks and months. Most were civilians. That is history; that is context.

Many of the critics believed that the contents of the labels should be limited to artifact identification. Paul Tibbets, the pilot of the *Enola Gay*, said that history would be best served by that approach. Many museum curators around the nation would agree with him. There is a long-standing debate among museum curators over the context issue. Some curators say that artifacts should speak for themselves, and they cite the traditional role of bare-bones labels in art museums, which usually identify the artist, the year the work was completed, and the title of the work, if it has one.

But works of art are not the same as museum artifacts. The essence of art is that it is a subjective expression of an artist. That is why it is "art" instead of a mailbox or a screwdriver or a paper clip. A work of art has as many subjective meanings as it has viewers. But in this context, the fuselage of the *Enola Gay* and the carbonized remains of a child's lunch are not *objets d'art*. They are *evidence*—surviving fragments of past events.

By the end of 1994, on orders from Harwit, the curators had done four revisions of the script, the last two in close consultation with American Legion critics. In the first revision, a "pre-exhibit" display occupying some 4,000 square feet was added, containing 50 photos, some of which depicted Japanese atrocities early in the war. The pre-exhibit also would have displayed a U.S. carrier-based fighter plane.

The final two revisions involved line-by-line consultations between representatives of the American Legion and the curators. Among the changes: the removal of archival documents showing that some government officials and military leaders did not believe the bomb should be used, and that some highly placed U.S. officials thought the target city should at least be warned. The curators were also forced to eliminate some artifacts and photos. The lunch box, for instance, had to go.

The most difficult issue was the question of American casualties. The Air Force Association and the American Legion argued that the bombs were used to end the war quickly, thus avoiding the need for an invasion of the Japanese home islands, which would have produced perhaps a million or more U.S. casualties. Few historians who have looked closely at the documentary record believe that any high-level military planner actually thought that in 1945.

Harwit and the American Legion representatives eventually *negotiated* a figure—229,000—for the expected number of U.S. casualties, if Project Olympic, the invasion of Kyushu planned for November, had taken place. Then—in mid-September—the American Legion pronounced the exhibit flawed, but passable. The Air Force Association was still unhappy.

Agreeing to a figure of 229,000 was a mistake. Those of us on the advisory board who were familiar with the documentary evidence knew the casualty figure was still high. The generals and admirals who were actually planning the invasion were projecting lower numbers for the invasion of Kyushu. Barton Bernstein, a Stanford historian who has looked at the question for years, persuaded Harwit that, in light of the available evidence, 63,000 casualties was a better figure. And on January 9, Harwit informed Legion officials that the script was being changed accordingly.

That was the final insult, insofar as the American Legion was concerned. From the perspective of the Legion, Harwit had broken his word. The Legion—backed by several members of Congress—called on Smithsonian Secretary I. Michael Heyman and President Clinton to take the exhibit out of the hands of Harwit and his curators, at the very least. But what they really hoped for, they said, was

that the Smithsonian would cancel the exhibit altogether.

As William M. Detweiler, the commander of the American Legion said, the museum leadership had managed to antagonize everyone on all sides of the issue.

Act Three: The cave-in

On January 30 of this year, Smithsonian Secretary Heyman announced the cancellation of the original *Enola Gay* exhibit. In its place, he said, would be a simple display of the front portion of the *Enola Gay*'s fuselage and perhaps some videotaped interviews with surviving crew members.

"I have taken this action, for one overriding reason," Heyman said. "I have concluded that we made a basic error in attempting to couple an historical treatment of the use of atomic weapons with the fiftieth anniversary commemoration of the end of the war. But we need to know which of many goals is paramount, and not confuse them.

"In this important anniversary year, veterans and their families were expecting, and rightly so, that the nation would honor and commemorate their valor and sacrifice. They were not looking for analysis, and frankly, we did not give enough thought to the intense feelings such an analysis would evoke."

The scaled-down exhibit will open in June instead of the middle of May, as originally planned. Many historians said they were relieved by the cancellation of the the full-scale exhibit, arguing that it had been so eviscerated that it was better not to mount it at all. I don't share that view. Yes, each new draft of the script bore the scars of censorship. But even in its damaged state, the exhibit would have challenged viewers to rethink their comfortable notions about Hiroshima and Nagasaki, the end of the war, and the origins of the Cold War.

In recent months, I have privately discussed the stillborn exhibit with some members of the American Legion. And it is clear that the motives and concerns of the Legion and the Air Force Association were, in some respects, fundamentally different.

Air Force Association press releases as well as the remarks of individual members of the association suggest that their campaign to discredit the *Enola Gay* exhibit was designed, in part, to embarrass the Smithsonian and force the resignation of Harwit. Under that scenario, he would have been replaced with someone whose idea of a good museum was strictly celebratory—and therefore congenial with the Air Force Association's views.

For the American Legion, the issue was much different. From a Legion perspective, the exhibit appeared to slight the contributions that veterans of the Pacific war made to victory over Japan. When *Post* reporter Ringle interviewed Grayford C. Payne, the prisoner of war quoted a moment ago, Ringle noted that the curators had said the question of whether it was necessary and right to drop the bombs still "continues to perplex" the nation.

To Payne, the curators sounded as if they were saying "that the thousands of Japanese killed by those bombs were somehow worth more than the thousands of American prisoners in Japan. . . . After all we'd been through? . . . What about the women and children I saw bayoneted and buried alive . . . by the Japanese in the Philippines? What about the hundreds of thousands of Chinese hacked to pieces in the Rape of Nanking?"

Perhaps it is no overstatement to say that for the American Legion, the issue was sentiment. But for the Air Force Association, the issue was power. It wanted "its" museum back.

The fallout

Some say that the big loser in the *Enola Gay* flap was the public, not the Smithsonian. There's some truth to that. Ordinary men, women and children have been denied the opportunity to assess different interpretations—supported by artifacts and documents—regarding the end of World War II, which have emerged from an intense study of the documented views and actions of the major actors who shaped the events in the Pacific in the summer of 1945.

In this fiftieth anniversary year of the end of the war, there is no dearth of information about the bombings. There has been an explosion of articles, books, and television specials about the first and only uses of atomic weapons in warfare, each presenting a distinctive and sometimes unique interpretation of the evidence concerning the motives behind the decisions of our leaders. Unfortunately, if someone wants to see an interpretation accompanied by actual artifacts that bear on the story, he or she will have to visit Hiroshima or Nagasaki.

The public *was* a big loser. But so was the Smithsonian. Last year, the administration of the Air and Space Museum forced the curators of the exhibit to negotiate directly with representatives of lobbying groups like the Air Force Association and the American Legion.

Meanwhile, 28 members of Congress signed a letter to the secretary of the Smithsonian denouncing the exhibit and urging him to intercede. Director Harwit was confronted by 21 members of Congress, some of whom wanted to know why the curators were being so un-American. Sen. Christopher "Kit" Bond, a Republican from Missouri, wrote a letter to one of the curators, accusing the curator of being un-American. Bond said he would keep his eye on the curator.

As the controversy unfolded, I suggested to Harwit and the curators that the advisory board could play a useful role as a buffer between the curators and the critics. That idea got nowhere.

In September, I resigned from the advisory board, as a protest. I was outraged that the museum administration had exposed the curators to the direct pressure of organizations such as the Air Force Association and the American Legion. And I was thunderstruck when members of Congress became actively involved.

The fact that a significant portion of the funds for the Air and Space Museum comes from public sources no more entitles members of Congress—or anyone else—to censor the conclusions of sound historical scholarship than does the fact that public monies support other kinds of research and writing projects.

That kind of thought control should have no place in a government committed to democracy. I believed that that issue had been settled in the 1950s, when McCarthyism was laid to rest. Apparently I was wrong. ■

NOTHING CLEAN about "CLEANUP"

By LINDA ROTHSTEIN

Photos by ROBERT DEL TREDICI

It's going to take $230 billion, spent over 75 years, to stabilize, not clean up, the weapons complex.

Over the past 50 years, the United States has spent hundreds of billions of dollars—at 1995 rates—to design and manufacture nuclear weapons. Now that the East-West arms race has finally ended, the nation may have to spend hundreds of billions more just to stabilize the poisonous mess left in the weapons complex.

Although her predecessors were all cut from the same secretive military cloth, Energy Secretary Hazel O'Leary has flung open the windows and doors, presenting the weapons complex's problems for public inspection. Two of the department's reports issued this year—*Closing the Circle on the Splitting of the Atom*, a generously illustrated survey designed for the general public, and *Estimating the Cold War Mortgage*, a massive study prepared for Congress—underline how difficult the mess will be to clean up.

In fact, both reports make it plain that "cleanup" is the wrong term. Most of the weapons complex is not going to be cleaned up in the foreseeable future. Merely stabilizing the wastes is an enormously sophisticated technical enterprise.

The Energy Department estimates that a comprehensive cleanup could cost in the range of $500 billion over 75 years. The more conservative $230 billion figure presented in *Cold War Mortgage* is a baseline cost (in 1995 dollars) that would be spread out over the next 75 years. That money would buy "stabilization" of the worst sites, not cleanup.

Many parts of the weapons complex have long been poised precariously on the brink of environmental disaster. There is much to do: sites must be "characterized" (the contents of three-fourths of the units at weapons production sites that may leak contaminants into the environment remain to be assessed); nuclear materials that are now stored in aging facilities must be stabilized; and a variety of toxic wastes must be stored safely until they can be moved to permanent repositories.

Energy's message comes at an awkward time for would-be budget-slashers in Congress, who might prefer to downplay the weapons complex's problems. The president's proposed 1996 budget reduces funds for environmental management by 4 percent, and congressional budget-cutting enthusiasts may want to cut more deeply. Even more threatening to cleanup is a Republican proposal in the House of Representatives to eliminate four cabinet-level departments, including the Energy Department. If nuclear-weapons "stewardship" is turned over to the Defense Department, as has been suggested by some government downsizers, it is not clear who would manage the environmental liabilities left by the weapons production process.

Environmental remediation will need forceful advocates over the 70 years the baseline study estimates it will take to accomplish the task.

As its authors warn, *Cold War Mortgage*

Closing the Circle on the Splitting of the Atom, *an impressive report produced for the general public, is a January 1995 publication of the Energy Department's Office of Environmental Management. A copy of* Closing the Circle *may be obtained by calling the Environmental Management Information Center at 1-800-736-3282.*

Linda Rothstein is managing editor of the Bulletin.

presents only a gross estimate of costs, in part because the Energy Department's environmental task is without technical precedent. The department faces some problems for which no solutions are yet available. For example, there is no known remedy or technique for decontaminating groundwater.

Although the costs are uncertain, there are some painful certainties: *Cold War Mortgage* estimates that remediation will include disposing—somehow—of 403,000 cubic meters (106 million gallons) of high-level radioactive wastes; 2,600 metric tons of spent fuel; 107,000 cubic meters of transuranic wastes; 1,800,000 cubic meters of low-level radioactive waste; and 780,000 cubic meters of "mixed" (chemical and radioactive) waste. And there are the as-yet-unanswered questions about what can be done in the many cases where plant operations have contaminated the soil and groundwater.

Where waste water was dumped on the ground and stored wastes leaked into the earth, volatile organic compounds, heavy metals, and radionuclides have spread to surface streams and groundwater. There is no way to restore the groundwater. The baseline report simply recommends two approaches that might be called "holding actions": trying to eliminate further contamination, which includes repairing still-leaking storage sites; and, in some cases, blocking the migration of contaminated groundwater before it reaches major sources of drinking water.

The cost of remediation in the case of some river systems—the Columbia River (Hanford Site), Clinch River (Oak Ridge), and Savannah River (Savannah River Site)—was omitted from the baseline plan because no effective remediation technique is available. In some cases, remediation efforts themselves could cause unacceptable ecological damage. Some water is being treated at the Savannah River Site, but the treatment is expensive and of unknown efficacy.

A worker at Hanford's Plutonium Finishing Plant manipulates plutonium inside a glovebox.

Because it is impossible to destroy radionuclides and other contaminants like heavy metals, the Energy Department's baseline study rejects the "greenfields" concept—the idea that all nuclear weapons production sites can or should be returned to their original condition. Instead, the department's cost estimate is based on "in-place containment" whenever possible. Containment also offers the advantage of producing little or no secondary waste. Nearly every removal technology will produce additional waste during the transportation, storage, treatment, and final disposal stages.

The following is a summary—based on *Closing the Circle* and *Estimating the Cold War Mortgage*—of the waste products that must be managed and the steps in the weapons production process that created them.

How did we get in this mess?

The creation of each gram of plutonium, reactor fuel element, and container of enriched uranium produced radioactive waste—virtually all of which remains with us today. The graphite bricks Enrico Fermi used for the first "atomic pile" at the University of Chicago were buried in a Cook County forest preserve. The acid used to extract plutonium for the first atomic test in the New Mexico desert is still stored at the Hanford Site in the State of Washington.

Not only do all the wastes remain, they pose a variety of hazards. Many are so toxic that they must be isolated for hundreds of centuries, and they need special treatment before they can be permanently disposed of.

During all of the nuclear weapons production period—and especially between 1943 and 1970—the nuclear weapons industry handled many wastes with little thought to the future. Billions of gallons of waste water were poured on the ground. Other liquid wastes were dumped into evaporation ponds, from which radioactive materials leaked, contaminating the soil and groundwater.

Weapons-complex wastes range from intensely radioactive acids used to separate plutonium to slightly radioactive items of clothing or chemical solvents used in purity tests. They differ in physical characteristics, chemical form, and radioactivity, and they need to be handled and stored in different ways. Among the great challenges to cleanup are the many deteriorating, unlabeled or unidentified waste containers whose precise contents are not known.

Waste has been the most abundant product of every step in the weapons production process: uranium mining and milling, uranium enrichment, handling spent fuel, spent fuel reprocessing, and plutonium production and plutonium parts manufacture.

Mining and milling. The United States mined about 60 million tons of ore to produce 994 metric tons of highly enriched uranium and about 100 metric tons of plutonium. It takes about 1,000 tons of uranium ore to produce one kilogram of plutonium.

The ore was first processed to produce concentrated natural uranium or "yellowcake," leaving behind vast quantities of slag or "tailings." These mill tailings (which contain toxic

A worker at the Idaho National Engineering Laboratory decontaminates a metal cask that held irradiated fuel. Behind him, spent fuel rods cool in a pool holding 22 million gallons of water.

heavy metals, radium, and thorium) account for only a small fraction of total radioactivity in weapon production waste, but they constitute 96 percent of the total volume of waste. Tailings were typically abandoned, with some material blown away by the wind or washed away by rain. In 1978 Congress passed a law to insure that these mill tailings, whose major threat to safety is the radon they emit as a byproduct of radioactive decay, would be stabilized.

Enrichment. At the enrichment plants, uranium 235 was separated from the more abundant isotope, 238. But most of the material fed into the plants came out as "depleted uranium," also known as enrichment tails. About 600,000 metric tons of somewhat radioactive depleted uranium are stored in Ohio, Tennessee, and Kentucky. Enrichment plants contaminated the environment with solvents, polychlorinated biphenyls (PCBs), heavy metals, and other toxic substances.

At the uranium foundry in Fernald, Ohio, hundreds of tons of enriched uranium (in gaseous form) were converted to crystals, then blended with magnesium granules. When the mixture was cooked in a furnace, it ignited, converting the crystals to metal. Fernald's environmental legacy includes the release of uranium dust and landfills that have leaked chemical wastes.

Spent fuel. The United States operated 14 nuclear reactors that produced plutonium and tritium for nuclear warheads. The last of these reactors was shut down in 1988. Most of the fuel rods and targets that were irradiated in the reactors were reprocessed to extract plutonium and leftover enriched uranium.

When large numbers of weapons were being produced, the spent fuel was stored only long enough for some radioactive decay to occur before reprocessing. But as warhead production declined, reprocessing tailed off. In April 1992, when the Energy Department announced that it was ending reprocessing, approximately 4,630 metric tons of spent fuel was stored in nearly 30 storage pools. (The Energy Department prefers to use a 2,600-metric ton figure, which represents the mass before the material was used as fuel.)

Nearly all of this fuel remains at the Hanford Site in Washington State, the Savannah River Site in South Carolina, the Idaho National Engineering Laboratory, and West Valley, New York, most of it in indoor pools of water that must be cooled and filtered. Some older spent fuel is in dry storage.

Although Energy has less spent fuel to contend with than does the commercial nuclear power industry, the two cannot be compared. Unlike commercial fuel, spent fuel from production reactors was not designed to be stored for any length of time. Its outer layer or "cladding" corrodes if it is stored in water. (But proper control of water chemistry can prevent or reduce corrosion.)

Eventually, the spent fuel will be placed in a deep geologic repository—when such a burial site becomes available. In the meantime, it must be stored above ground, and many of the existing storage facilities—some nearly 50 years old—do not meet safety standards. Some storage pools are unlined, with inadequate means for controlling water chemistry. Under some circumstances, both the rusted cladding and uranium will burn when exposed to air. A worst case scenario includes conditions that could lead to an inadvertent nuclear chain reaction or "criticality" event.

Today, the spent fuel considered to be at highest risk is being moved from old storage sites, repackaged, stabilized, and placed in more secure locations. At the Idaho Laboratory, a storage pool that is earthquake resistant and can be chemically controlled is being used to consolidate spent fuel from other parts of the laboratory.

In contrast, Hanford's radioactive sludge and spent fuel are stored in aging tanks a few hundred yards from the Columbia River. One basin has leaked millions of gallons of contaminated water into the ground. Workers at Hanford are now beginning to move spent fuel and sludge away from the river, and an environmental study is looking into alternate storage. In the meantime, Hanford's pools must be repaired to minimize leaks and make them less susceptible to earthquake damage.

Because it is safer and more reliable over the long-term, dry-cask storage will probably be used for spent fuel that has cooled long enough. The spent fuel from the N Reactor at Hanford is a candidate for this treatment.

When a deep underground repository is available, the spent fuel will have to be encapsulated in metal containers that meet the requirements for long-term (10,000-year) performance. Damaged fuel will probably have to be processed before it is stored. The department may need to process spent fuel that contains uranium enriched to the weapon-grade level to avoid both potential security and criticality problems. But new technologies, such as "minimal dissolution and non-extractant solidification" might make it possible to stabilize spent fuel without reprocessing.

Reprocessing. Reprocessing of spent fuel produces the most chemical and radioactive wastes and is the most environmentally costly of all weapons-related work. Reprocessing wastes contain 99 percent of all the radioactivity produced in the weapons production process (see table).

After spent fuel was irradiated in a production reactor, the plutonium and uranium had

Reprocessing—separating plutonium—accounts for 99 percent of all the radioactivity in Energy's waste products.

Waste tanks were often filled with little regard to what mix was being created.

to be recovered—separated from the remaining material, which includes a variety of intensely radioactive fission products. The spent fuel was dissolved in acid and chemically separated, with the acids and chemicals used in the reprocessing retaining most of the radioactivity. The intense radioactivity is caused by the relatively rapid decay of fission products. This waste will generate only one-tenth as much heat and radiation after 100 years, and it will have decayed to one-thousandth of its original level in 300 years. Rapid decay may make its ultimate disposition easier, but high-level waste must still be isolated from the environment for a long time—essentially for as long as spent fuel.

Hanford had five reprocessing facilities, Savannah River two, and Idaho one. These reprocessing buildings, and the underground tanks where their wastes are stored, are among the most radioactive places in the United States. Four of Hanford's plants and one at Savannah River extracted plutonium. Two others—the second at Savannah River and the one in Idaho—extracted highly enriched uranium from spent fuel. At the fifth Hanford facility, uranium was recovered from high-level waste. The government also built and operated a demonstration plant in West Valley, New York for reprocessing commercial fuel.

These operations produced about 100 million gallons of high-level waste (the equivalent of 10,000 tanker trucks full). Most of it is stored in underground tanks in Washington, South Carolina, Idaho, and New York. The tanks contain a variety of radioactive liquids, solids, and sludges. Some of the liquid has been converted to a dry, concentrated form. (For more on Hanford's high-level waste, see "177 Tanks, 177 Problems," page 39.)

When the emphasis was on weapons production, the tanks were often filled with little regard to what sort of a brew was being created. The waste was not generally sampled and records were not kept. As a result, the Energy Department does not know all of the wastes' characteristics.

These high-level wastes will remain radioactive for centuries, and the department is working on ways to convert them to more stable forms. At the Idaho site, a calcining facility heats liquid high-level waste to convert it to a dry powder, which is more stable and lower in volume. Direct human contact with the waste is still dangerous, however, and dry waste can be easily dispersed. High-sodium wastes cannot be converted because they clog the spray nozzles in the calciner.

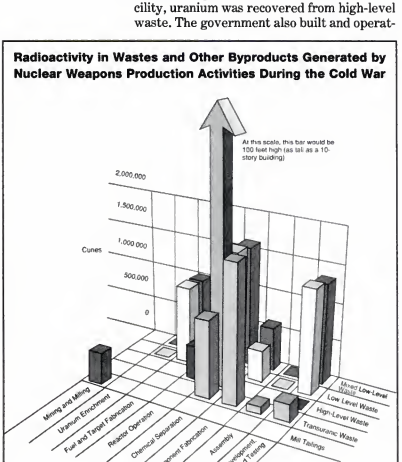
At the three other sites where fuel was reprocessed, the acidic wastes were neutralized, then stored in carbon steel tanks. The department intends to mix these sludges, saltcakes, and liquids with molten glass (in a process known as vitrification), then pour the glass into metal cylinders. The Energy Department is building two vitrification facilities. One is a $2 billion plant at the Savannah River Site, which has been plagued by delays and cost overruns; the other is a smaller plant at West Valley, New York, which is scheduled to begin operations this year.

Transuranic waste. Plutonium production also created "transuranic" waste, which is a term used for any material that contains significant quantities of plutonium, americium, or other elements whose atomic weights exceed that of uranium. Transuranic waste includes everything from the chemicals used in crafting plutonium metal to the air filters, gloves, clothing, tools, and piping used in the plant.

Accidents have also generated transuranic waste. There were a number of fires at Rocky Flats that generated thousands of drums of transuranic waste, much of which was shipped to the Idaho Laboratory for storage.

The nuclear weapons complex has about 100,000 cubic meters—enough to fill half a million 55-gallon drums—of transuranic waste, much of which was put in "temporary storage." Some temporary containers have corroded and

Radioactivity in Wastes and Other Byproducts Generated by Nuclear Weapons Production Activities During the Cold War



Source: *Closing the Circle on the Splitting of the Atom.*

need to be repackaged and relocated.

Thousands of drums were left exposed to the elements, and as a first step they have now been placed on covered concrete or asphalt pads. Other transuranic wastes remain in earth-covered berms that were expected to hold them for only a few years.

New storage facilities must be built, and corroding or leaking drums will have to be encased in clean metal containers. But these steps are temporary; these wastes are destined eventually for geologic storage.

Because of their long-lived radioactivity, transuranic wastes must be permanently isolated from the environment and from contact with people. The Waste Isolation Pilot Plant (WIPP) in New Mexico was built several years ago, and experiments are under way to study how waste materials would interact with the environment there. No wastes have yet been taken to the site, and there is local opposition to its use. If WIPP does become a permanent disposal site, much of the transuranic waste from the weapons complex will be stored there.

Low-level waste. Low-level waste is a catch-all term for waste that is neither high-level, transuranic, spent fuel, or mill tailings. It includes rags, clothing, contaminated equipment, waste created by decontamination efforts, construction debris, filters, and scrap metal. Most low-level waste is packaged in drums or boxes and buried in shallow pits or trenches. Approximately 3 million cubic meters of waste has been disposed of in this manner.

But low-level wastes continue to be generated in the process of site cleanup and the management of other wastes. Eighty percent of newly generated waste is low-level.

Newly generated low-level waste is disposed of in a way that meets safety standards, and it does not pose a significant threat to the environment. But low-level waste was not always disposed of so carefully. Some older disposal sites have already been excavated and the waste repackaged. Other disposal sites are now being evaluated.

At Rocky Flats, 700,000 gallons of contaminated sludge from five solar evaporation ponds are being consolidated at a single pond and transferred to 70 large, double-walled polyethylene tanks. Researchers at Rocky Flats believe it may be possible to mix this waste with recycled polyethylene so it can be poured into drums or other forms for disposal. Large quantities of discarded polyethylene containers can be found in landfills, and it takes a very long time for plastic to degrade.

Low-level wastes at Fernald may be vitrified. In a process similar to the vitrification planned for high-level wastes, it will be encased in glass pebbles, or "gems." At Oak Ridge, where two new facilities will be built in 1995 and 1998, low-level solid waste is stored in containment wells. Savannah River has constructed and begun operating some low-level waste vaults. It will close its trench burial site in 1995.

Some low-level wastes that require greater confinement may be disposed of at Hanford or at the Nevada Test Site, where new facilities will also be built.

Hazardous and mixed wastes. Legally, "hazardous" waste contains certain chemicals or

"177 tanks, 177 problems"

The waste tanks at the Savannah River Site, West Valley, and Idaho all have serious problems that deserve attention, but the leaking tanks at Hanford are infamous.

The tank farms at the Hanford Site hold 61 million gallons of liquids and sludges. The contents include radioactive waste and spent fuel from nine weapons production reactors mixed with assorted hazardous chemicals, including nitrates and nitrites, chromium, mercury, and cyanide. By the early 1990s, 24 of the tanks were considered in some danger of exploding, according to William Alumkal, who is the executive vice president of Westinghouse Hanford's tank waste remediation division.

Alumkal describes tank management problems in the March 1995 issue of *Nuclear Engineering International*. The 177 tanks, he reports, hold wastes that were first neutralized, and then concentrated and mixed to reduce them in volume before storage. Because the wastes were mixed, each tank has different contents and presents different problems.

Sixty-seven of 148 single-wall tanks that were built between 1943 and 1964 are known to have leaked, or are suspected of leaking their witches' brew into the ground. Twenty-eight double-walled tanks were built between 1968 and the mid-1980s, and none of the newer tanks has leaked. But the newer tanks are not large enough to hold all the current waste and the additional waste that will be generated by cleanup.

More than 50 of the tanks were on a "watch list" pending the resolution of a number of previously "unreviewed safety questions." Six of the tanks have now been removed from the list.

The most famous of Hanford's potentially explosive tanks, the 101-SY, slowly built up hydrogen gas, which it would periodically vent. In July 1993, a pump that slowly mixes and circulates the liquid wastes was installed in this "burping" tank. Mixing prevents gases like hydrogen from accumulating to dangerous levels in the thicker sludges at the bottom of the tank.

Hanford's tanks must be managed until the wastes can be moved to a deep geologic repository. But that transfer, as Alumkal indicates, will not be easy. "Because hydraulic sluicing may not be effective or useful on hardened sludges, nor environmentally sound, because of tank leakage and additional potential contamination, we need to find better methods. Our strategy is to use proven separation technologies where possible, but more advanced methods may be needed to remove a greater proportion of radionuclides or to decrease the actual amount of high-level waste."

—*L. R.*

exhibits dangerous characteristics like ignitability or corrosivity. These wastes must be handled in compliance with the Resource Conservation and Recovery Act (RCRA). Some states have additional laws governing dangerous chemical wastes.

The Energy Department's hazardous wastes resemble those produced by many private companies. They include organic solvents, sludges from degreasing operations, and heavy metal from unrecycled batteries.

Like many private companies, the Energy Department has often failed to take adequate care in handling, storing, treating, or disposing of hazardous wastes. The result is substantial environmental contamination. In some cases, stored waste is discovered for which no records are available; these "unknowns" are particularly difficult to manage. For the most part, however, Energy ships hazardous chemical wastes to private vendors for disposal.

Storage silo for calcined—dry—waste at the Idaho National Engineering Laboratory.

But unlike most private companies, the weapons complex produced large amounts of "mixed" wastes—wastes that are both radioactively contaminated *and* chemically hazardous. RCRA requires that this otherwise low-level waste be stabilized in preparation for disposal, and Energy must now deal with a considerable backlog.

The department must manage 780,000 cubic meters of mixed waste at 22 sites. New treatment technologies like very-high-temperature plasma furnaces and vitrification are now being considered as well as current treatment methods such as incineration and cementation. It will take many years to develop technologies, build facilities, and treat the backlog.

Plutonium. When the plants that manufactured plutonium parts for nuclear weapons—Rocky Flats, Hanford, and Savannah River—were shut down, about 26 tons of plutonium were left in intermediate stages. This stranded plutonium is in a wide variety of forms, from plutonium dissolved in acid to rough pieces of metal to nearly finished weapon parts.

Rocky Flats has about 12.8 metric tons of plutonium, about 6.6 metric tons of it in the form of plutonium metal. Scraps of metal and chemicals that contain plutonium worth recovering were stored in drums and cans. Other unknown amounts of plutonium have collected on the surfaces of ventilation ducts, air filters, and gloveboxes.

Handling plutonium requires care, but the complex conditions at the weapons plants make for an even greater challenge. Radioactivity combined with corrosive acids is slowly destroying some of the plastic bags and bottles plutonium is packed in. Hydrogen gas is accumulating inside some of the sealed cans, drums, and bottles that clutter the aisles and fill the gloveboxes. Bulging and ruptured containers have been found. Both the hydrogen and some of the plutonium could ignite and burn. At Hanford and the Savannah River Site, plutonium is slowly collecting on the bottoms of tanks, where enough of it could produce a criticality event.

Plutonium must be inspected, guarded, and accounted for, and the buildings that house it must be maintained, including ventilation systems, air filters, and fire and radiation alarms.

At Rocky Flats, bottles must be emptied, tanks drained, and liquids solidified. Pipes are being shrink-wrapped to avoid leaks and new drains are being installed to collect the liquids left in pipes and tanks. Most of the liquid waste at Rocky Flats is expected to be solidified within two to three years.

In contrast, Savannah River's two chemical separation plants hold more than 95,000 gal-

Checking for contamination at Rocky Flats.

lons of liquids that contain dissolved plutonium. If no other solution is found, a Savannah River plant may have to be restarted to separate this plutonium.

Plutonium "pucks" or "buttons" and other forms of plutonium metal are kept in storage vaults. These forms were stored in metal containers enclosed in plastic bags. In some cases, there are no records of what the packages contain. If it is exposed to air, plutonium can "rust," becoming a flammable powder.

The containers must be opened in sealed "gloveboxes" and the rust brushed off and treated. The metal and powder will then be repackaged separately, without plastic, to prevent this problem from recurring.

Plutonium parts not in operational warheads are stored at various facilities across the country. The supply increases steadily as weapons are dismantled at the Pantex Plant in Texas.

In December 1993, Energy Secretary Hazel O'Leary declassified the fact that the United States had produced more than 100 metric tons of plutonium. The ultimate fate of this material is now under discussion. Because it cost billions to produce, some argue that it should be used to fuel nuclear power plants. Others have suggested that some of it should be used to fuel a new tritium-production reactor. Others contend that neither plan is economical (it would require a new type of plant to fabricate fuel rods using a mixture of uranium and plutonium), and that we should find the safest, fastest, and cheapest way to spoil the plutonium's usefulness in weapons. One proposal is to vitrify it along with high-level waste. Other suggestions include storage in deep geologic repositories or deep boreholes, or disposal beneath the seabed.

Tomorrow came

Many Cold War weapon builders sincerely believed they were in an all-out struggle for national survival. Careful storage of waste products just didn't seem as important as "winning" the Cold War by building up the nuclear arsenal as rapidly as possible.

Now that the Cold War is over, and with the advantage of hindsight, it is both easy and popular to criticize the bomb-builders' mistakes and deplore their production practices.

But, as the government focuses on cleaning up the weapons complex, it should be remembered that, if the present generation does not ask the right questions or press for carefully formulated decisions about environmental management, it will make its own set of mistakes. ■

Livermore on the defensive

By TOM ZAMORA COLLINA

Livermore's weapons program takes another hit—this time from the Energy Department's Task Force on Alternate Futures.

LAWRENCE LIVERMORE NATIONAL LABORATORY

In the early 1950s, Edward Teller, who had worked on "the super" while a member of the wartime Manhattan Project, persuaded the Atomic Energy Commission to establish Lawrence Livermore National Laboratory as a means of speeding work on thermonuclear weapons. Here he visits with President Lyndon B. Johnson.

Since the end of the Cold War, the future of the U.S. nuclear weapons laboratories has been in question. Budget cutters, arms controllers, and defense conversionists have been eyeing the multibillion-dollar facilities with increasing interest. Given current efforts to reduce federal spending, the Energy Department has promised to cut its budget by $8 billion over five years, and cost-reduction options abound. Talk of saving money by consolidating Energy's two intentionally redundant weapons design labs—Lawrence Livermore in California and Los Alamos in New Mexico—has been percolating for years.

The idea of shrinking the nuclear weapons-design complex came to national attention in 1992 with a bill sponsored by then-chairman of the House Science, Space, and Technology Committee, George E. Brown, Jr., a California Democrat. This bill would have required Energy to plan for the phased consolidation of the weapons laboratories. In 1993, incoming Energy Secretary Hazel O'Leary got this provision removed by creating a task force to look at the future of the labs. The Task Force on Alternative Futures for the Department of Energy National Laboratories, chaired by Robert W. Galvin, chairman of Motorola's executive committee, released its report on February 1. The report finds that the design complex can be significantly reduced.

The task force's review calls for transferring weapon design from Livermore to Los Alamos and Sandia National Laboratory, also in New Mexico, over a period of five years. O'Leary has indicated that the task force's suggestions will be taken very seriously: "I have no interest in putting the Galvin report on the shelf and continuing with the status quo."[1]

Shaky support for NIF

The plan for "stockpile stewardship"—maintaining warhead safety and reliability in the absence of nuclear tests (see the July/August 1994 *Bulletin*)—received a tentative thumbs-up from the task force. The Energy Department is stressing the need to build new simulation facilities to maintain nuclear weapons design skill through scientific experimentation. In ranking the priorities of stewardship, however, the report listed "sustaining the scientific process of inquiry through experimentation" dead last. Job Number One: "attracting and retaining skilled scientists, engineers and managers."

Nevertheless, the report shows support for all of the major projects in Energy's budget for fiscal year 1996, including continued funding for the Dual-Axis Radiographic Hydrodynamic Testing facility at Los Alamos; near-term support for the Los Alamos Neutron Scattering Center; the pursuit of advanced computing; and the construction of the National Ignition Facility (NIF) at Livermore. According to congressional testimony by Secretary O'Leary, "We are pleased by the Task Force's support for the department's science-based stockpile stewardship program, including support for the National Ignition Facility."[2]

The Galvin task force wants weapons work consolidated—and the group was split on NIF.

But the $1 billion NIF did not enjoy unanimous support, and the final report reflects an uncomfortable compromise. In its favor, the task force finds that NIF will provide "a unique means for doing very important experiments involving extremely high temperatures in condensed matter physics," and thus will be fundamental to maintaining nuclear weapons design expertise in this area and will contribute to general science and astrophysics.

But the Galvin report goes on to undercut every major justification for the NIF. "On the other hand," the report notes, "there is some possibility that NIF will inadequately simulate secondaries, although this is already a lower priority than understanding primaries." In other words, NIF's role in stockpile stewardship is questionable and of a lower priority than efforts to simulate the primary stage of a nuclear warhead.

As for NIF's role in future energy production, the report states that "there is a low probability that inertial fusion will become a useful source of energy in the foreseeable future." Even the baseline justification for NIF—that it will excite and thus keep weapons scientists at Livermore—is questioned: "NIF may not attract the scientists and engineers that stockpile stewardship really needs."

Most damning of all, the report recommends proceeding with NIF as a research facility "prioritized with respect to other major research investments." NIF is now being funded solely out of the defense budget. If it is put into competition with other basic research projects, "it won't stand a chance," said one task force member.

These conflicting statements reflect the range of views on the task force. In the end, the final decision on NIF was pragmatic—Secretary O'Leary had already approved it, Livermore needed it to survive, and the report had to get to the printer. According to Dan Kerlinsky, another task force member, "The group was split on NIF. Those of us with concerns felt comfortable with the language in the final report."

The issues of lab consolidation and stockpile

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"We just don't need this level of activity any more."

stewardship intersect at NIF. If NIF is built at Livermore as planned, this will "reinforce the weapons design capability at that laboratory," according to the report. This may aid Livermore's efforts to prevent consolidation.

Whither Livermore?

The NIF aside, the task force seems firm in its view that at least some consolidation is needed. The report concludes that "weapons modernization, arms control agreements, the fear of proliferation of weapons of mass destruction, and the significant decline in defense spending, require a restructuring of the laboratories' support for the national security mission."[5] Specifically, the report finds that "the restructuring will affect primarily weapons design capabilities, where the largest functional redundancy exists, and specifically Lawrence Livermore National Laboratory."

In a surprisingly bold move, the task force recommends a transfer of Livermore's weapons activities, including nuclear materials development and production activities, to Los Alamos and Sandia. This transfer would take place "as cost efficiency allows" and "as the requirements of science-based stockpile stewardship, support of the [Defense Department] nuclear posture, and the status of test bans allow." According to Herbert York, former director of Livermore and a task force member, "The Cold War is over, and we just don't need this level of activity any more. We need to move in the direction of less dependency on nuclear weapons."

The task force recommends that Livermore retain enough weapons design competence to continue its non-proliferation/counter-proliferation activities, as well as its activities in intelligence and verification. "Peer review"—independent assessment of such issues as warhead safety, reliability, and aging—should also be maintained until other approaches are found. In addition, sufficient expertise should remain to enable the lab to "participate in weapons-relevant experiments on the National Ignition Facility (NIF)." The report does not include estimates of possible cost savings from this limited consolidation.

Why phase out most weapons-design work at Livermore? As the task force points out, Livermore "supports only four of eleven weapons designs currently in the U.S. stockpile." This is generous. Only two Livermore weapons—the W87 and the B83 bomb—will be in service into the next century.

But political considerations are also a key element. The area around Livermore (not far from San Francisco Bay) has a higher population density than Los Alamos, and that population is not very supportive of Livermore's line of work. All told, Los Alamos has the rosier future.

Less regulation, more enterprise

The Galvin report begins with a simple statement: The 10 major Energy Department national labs have money, facilities and talent enough to carry out their traditional roles—research in the fields of national security, energy, environmental science and technology, and related aspects of basic science. However, the report also says that burdensome oversight and "micro-management" by the U.S. Congress and the Energy Department prevent the labs from efficiently using their resources. A list of the labs and their budgets (in millions) for fiscal 1995 follows:

Argonne National Laboratory, Illinois	$455
Brookhaven National Laboratory, New York	$340
Idaho National Engineering Laboratory, Idaho	$386
Lawrence Berkeley Laboratory, California	$226
Lawrence Livermore National Laboratory, California	$673
Los Alamos National Laboratory, New Mexico	$848
National Renewable Energy Laboratory, Colorado	$237
Oak Ridge National Laboratory, Tennessee	$548
Pacific Northwest Laboratory, Washington	$204
Sandia National Laboratories, New Mexico	$953

The Galvin report's main suggestions for improving the labs fall into four main categories:

Organizational structure. The centerpiece of the report is a suggestion to "defederalize" all the labs, with the possible exception of the three weapons labs. The labs would become independent non-profits run by government-appointed boards of directors. That would free them of excess bureaucratic oversight and "overregulation" and increase engineer/scientist input in management decisions. Although the federal government would still fund the labs, the government would be only a "consumer" of outputs, not a micro-manager of inputs.

Energy. The task force recommended improving energy research through a "portfolio" management approach. Energy would first need to create a "common framework of policy objectives"; then, Energy and its partners would develop a portfolio of programs to meet those objectives. All would be evaluated on their technological strength and maturity, potential contribution to public needs, and risk.

The task force did suggest one concrete change for en-

A primary argument against lab consolidation has been the perceived need for peer review in the nuclear weapons design program. Dismissing this point, the task force concludes that "there are many ways in which this peer review function can be served, and that peer review, in and of itself, does not justify the existence of two nuclear design laboratories." The task force does not recommend specific alternatives.

The Energy Department is taking a go-slow approach to this recommendation. O'Leary testified that "We have an initial favorable disposition for a careful phase-down of some of Livermore's nuclear weapons work, combined with a re-emphasis on non-proliferation, counter-proliferation, and verification activities. However, our actions proceeding down this path—the timing and the details—must depend on assessments of how best to meet our continuing national defense requirements in a wholly new era."[4] In other words, Livermore's fate will largely depend on how important its role may be in the stockpile stewardship program.

Politics will also affect this process. The new Congress is pressuring Energy to reduce its budget, but not its nuclear weapons activities. Of Energy's promised $8 billion reduction, none is envisioned to come out of defense programs. While some amount is expected to be saved as a result of the Galvin report's recommendations, where exactly the savings will come from has not been determined.

The task force said it sees no justification for transferring oversight of the weapons labs to the Defense Department. This idea has been raised by a number of independent studies as a way to improve the management of nuclear weapons programs.[5] The possibility of eliminating the Energy Department entirely—raised and then rejected by the Clinton administration in late 1994, and now being raised again by Congress—also leads to speculation about where the labs would go. As long as Energy remains intact, however, there seems little reason to shift lab management to Defense. ■

1. Hazel O'Leary, prepared statement before the Subcommittee on Energy Research and Development of the Committee on Energy and Natural Resources, and the Subcommittee on Energy and Water Development of the Committee on Appropriations, U.S. Senate, February 28, 1995, p. 4.
2. Ibid, p. 15.
3. Secretary of Energy Advisory Board, Task Force on Alternative Futures for the Department of Energy National Laboratories, *Alternative Futures for the Department of Energy National Laboratories*, February 1995, p. 11.
4. O'Leary, prepared statement, p. 15–16.
5. See, for example, *An Assessment of Defense Nuclear Agency Functions*, RAND, 1994; and *National Laboratories Need Clearer Missions and Better Management*, GAO/RCED-95-10, U.S. General Accounting Office, January 1995.

ergy research—a new focus on the emerging area of "industrial ecology." The task force proposed more research in environmental technologies: "clean" energy production, more efficient manufacturing processes, waste recycling, and energy-efficient materials.

Environmental cleanup. The report strongly criticizes Energy's cleanup efforts, particularly management's perceived failure to provide leadership. Some particularly angry words were reserved for Congress, Superfund legislation, and excessive oversight by Energy.

The report suggests that too many regulations, combined with litigation, force contractors to perform ineffectual "make-work" cleanup before a good technical solution can be developed. The task force proposed establishing an Environmental Advisory Board to help coordinate basic research, applied research, and field engineering and remediation efforts. The labs could help by identifying technical barriers to cleanup and pointing out problem areas in the complex.

Basic sciences. The report states that the labs do not make the best use of their strengths—namely, long-term, "high risk," multi-disciplinary research. The task force attributed this failure to a loss of focus on basic science, micro-management by Energy, declining research and development funding from defense, and poor budgeting. It recommended that the department:

- increase the commitment to fundamental science and engineering, especially physical sciences;
- maintain a balance between university and lab research facilities;
- separate the budgets for operating and maintaining facilities from specific program budgets;
- integrate basic research with technology development, especially in environmental remediation area; and
- eliminate barriers to personnel and information movement within and beyond the complex.

Economic role. The task force did not recommend economic development as a primary mission for the labs. But it suggests that certain programs can be structured to support U.S. industrial competitiveness. Lab directors would be in charge of creating and realizing such opportunities. However, these programs should be "spun off"whenever possible.

The task force found that the laboratories were "vulnerable to the charge" that the competitive playing field is being "unfairly tilted towards the laboratories' chosen partners" during the selection of Cooperative Research and Development Agreements (CRADA) partners. The task force called for more competition in the selection process and for more "rigorous technical and merit review" of CRADA programs.

—Alex Campbell and T.Z.C.

"Potatoes were guarded better"

By OLEG BUKHARIN and WILLIAM POTTER

Stealing nuclear fuel from the storage building at Sevmorput was—and may still be—easy.

On November 27, 1993, at about 1:00 a.m., Capt. Alexei Tikhomirov slipped through an unprotected gate and into the Sevmorput shipyard near Murmansk—one of the Russian navy's main storage facilities for nuclear fuel. The 35-year-old deputy chief engineer then climbed through one of many holes in the fence surrounding "Fuel Storage Area 3-30," sawed through the padlock on the back door, and pried open the door with a metal pole he found next to the building. Once inside, Tikhomirov located the containers of fresh submarine fuel, lifted the lid off container No. 23, and broke off parts of three assemblies for a VM-4-AM reactor core. Stuffing the pieces (containing 4.5 kilograms of enriched uranium) into a bag, he retraced his steps.

Outside the shipyard he was met by an accomplice, former naval officer Oleg Baranov. Baranov dropped Tikhomirov off at his home, and then drove to the nearby town of Polyarny, where he hid the nuclear material in his garage.

The third man behind this operation was Dmitry Tikhomirov, Alexei's younger brother, who at the time of the theft was chief of the refueling division at the shipyard. He had briefed his brother Alexei about security at the site, the holes in the fence, and the design of the fuel assembly.

None of the conspirators had a prior criminal record. They also lacked contacts for selling the stolen material, for which they hoped to receive $50,000. According to the official record of the investigation, they waited six months before they began to search for customers. But when Dmitry Tikhomirov told a fellow officer about the theft and asked for help in selling the stolen merchandise, the conversation was reported to a senior officer. In late June 1994, the three conspirators were arrested and the stolen fuel recovered.

The theft itself was discovered only 12 hours after it occurred. Carelessly, Alexei Tikhomirov had left the back door of the storage building open. Two guards on patrol noticed the discarded padlock and the broken door seal, and a prompt search revealed the broken fuel assemblies.

Tempting targets

The theft at Murmansk is only one of many diversions of nuclear materials that have occurred in Russia since the collapse of the Soviet Union. But unlike most previously reported thefts, the operation at Murmansk involved stocks of highly enriched uranium.

Enriched uranium is the standard fuel for propulsion reactors used in both Russian submarines and surface ships. The level of enrichment varies widely depending on the type of reactor—from approximately 20 percent, like that found in the fuel assemblies stolen from "Fuel Storage Area 3-30" at Sevmorput, to "weapon grade," which is usually defined as containing approximately 90 percent uranium 235.

Most Russian naval reactor fuel is not weapon-grade; it is enriched to between 20 and 45 percent uranium 235. More modern generations of submarine reactors, however, probably use higher enrichment levels. And the liquid-metal reactors that propelled Alfa Class submarines almost certainly were fueled with weapon-grade uranium.

Of the 600 kilograms of enriched uranium that was airlifted to the United States from the Ulba Metallurgy Plant in Ust-Kamenogorsk, Kazakhstan in fall 1994, several hundred kilograms were probably weapon-grade uranium intended for naval reactors. Russia's eight nuclear-powered icebreakers also use uranium enriched to 90 percent, and some other propulsion reactors were designed to use weapon-grade uranium fuel.

The size of Russia's propulsion fuel stockpile is difficult to gauge. It is even more difficult to estimate quantities by enrichment level. What is

JOSHUA HANDLER/GREENPEACE

August 1993: Nuclear submarine fuel offloading pier, Murmansk, Russia.

known is that the Soviet Union and Russia built over 250 nuclear-powered vessels—mostly submarines, but also surface ships, including the icebreaker fleet. Most of these vessels have two pressurized-water reactors which, under normal operating conditions, require refueling every 7 to 10 years. The cores of these reactors typically hold between 200 to 300 fuel assemblies, each containing several fuel rods. If this fuel has been enriched to 90 percent or higher, about 10 fuel assemblies could supply enough highly enriched uranium for a bomb.[1]

Although financial difficulties, old age, and the START treaties have led to the decommissioning of many Russian submarines, huge stocks of fresh fuel remain at five main storage sites that serve Russia's Northern and Pacific Fleets—Shipyard No. 35 at Sevmorput near Murmansk, the "Sevmash" Shipbuilding Plant at Severodvinsk, the naval base at Zapadnaya Litsa west of Murmansk, and two "technical repair bases" near the Gornyak Shipyard at Krashennikova Bay and by the "Shkotovo-22" Shipyard at Chazhma Bay. Fresh fuel is also stored on a short-term basis at land-based facilities or on refueling ships at other submarine bases, including Gremikha, Bolshoi Kamen, and Shipyard No. 10 ("Shkval") at Polyarny. Fuel for the nuclear icebreakers is stored at the "Atomflot" service base north of Murmansk.[2]

Joshua Handler, a Greenpeace researcher who visited a number of Russian naval facilities in the Russian Far East in mid-1994, reports that a steady supply of fresh fuel was delivered to the Chazhma Bay Shipyard storage site between 1990 and 1993.[3] He reports that in 1993, fresh fuel for 48 reactors—enough to refuel 24 submarines—was stored at the site. Much of this fuel was unusable, either because it was suited only for already-retired first-generation submarines or because it was damaged.

The possible diversion of materials from these very large stocks of highly enriched naval fuel is worrisome, even if most of the stocks would be of little direct use in building nuclear weapons. Their utility in fueling a bomb depends both on the composition of the fuel and its enrichment level. Most Russian naval reactors use fuel composed of uranium-aluminum blends. Some reactors, however, use uranium metal alloys (uranium-beryllium or uranium-zirconium) or uranium oxide ceramics. Only uranium oxide is directly usable in a weapon, although conversion of the oxide to metal would be preferable. Using the other compositions would require a difficult and time-consuming chemical separa-

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Russian Naval Reactor Fuel

Type of vessel	Number/type of reactor	Percent uranium 235
First-generation submarines (1958–68)		
Hotel, Echo, November	2 PWR*	<21
Second generation submarines (1968–present)		
Charlie	1 PWR	<21
Victor, Delta, Yankee	2 PWR	<21
Third generation submarines (1987–present)		
Typhoon, Oscar	2 PWR	21–45
Akula, Sierra, Mike	1 PWR	21–45
Other submarines		
Papa (1969–late 1980s)	2 PWR	Unknown
November-645 (1963–68)	2 LMR**	90
Alfa (1969-present)	1 LMR	90
X-ray, Uniform, AS-12 (1982-present)	1 PWR	Unknown
Icebreakers		
Lenin (1959–65)	2–3 PWR	5
Arktika (1975-present)	2 PWR	up to 90
Sevmorput (1988-present)	1 PWR	90
Taymyr (1989-present)	1 PWR	up to 90
Cruisers (1980–present)		
Kirov	2 PWR	Unknown
Communications (1988–present)		
Kapusta	2 PWR	Unknown

*Pressurized water reactor. **Liquid metal reactor.

Source: Joshua Handler, *Greenpeace.*

tion process, although this would not be an insurmountable obstacle for most would-be national proliferators.

Holes in the fence

According to Mikhail Kulik, the special investigator for the Northern Fleet Military Procuracy—and the chief investigator of the Sevmorput diversion—potatoes were guarded better than radioactive materials at the time of the theft at Murmansk. "On the side [of the shipyard] facing Kola Bay, there is no fence at all. You could take a dinghy, sail right in—especially at night—and do whatever you wanted. On the side facing the Murmansk industrial zone there are . . . holes in the fences everywhere. And even in those places where there aren't holes, any child could knock over the half-rotten wooden fence boards."[4]

Kulik reports that some security improvements were made after the theft. The number of guards were increased, and they were issued walkie-talkies. Planks from crates were torn off and nailed to the fence to cover some of the gaps, and barbed wire was added. Although more sophisticated alarm systems were proposed, they were not put in place because of cost. Reportedly, there still are no surveillance cameras around the perimeter, and the integrity of the fuel containers is checked by sight only. According to Kulik, the first and last time the contents of most of the containers was checked was at the fuel-fabrication plant. He believes the diversion at Sevmorput "could have been concealed for 10 years or longer," had the open door of the storage building not attracted the guards' attention.[5]

It is difficult to know if the security deficiencies at Sevmorput are typical. In contrast, Greenpeace's Handler describes what appear to be sophisticated material-control procedures at Chazhma Bay. When fresh fuel arrives by rail, facility authorities are supposed to verify the integrity of seals on the fuel containers and then transfer the fuel to the storage building. During storage, the accountability and control system employs paper records, access control, seals, and frequent inventory checks.

According to Handler, access is restricted and can only be granted by two guards who must be informed about the visit in advance. Each duty officer has a set of keys; two sets are required to open the doors. No unaccompanied visitors are allowed to enter the site. Handler was told that the fuel inventory is checked daily, and that the daily inspections are supplemented by weekly, monthly, and quarterly inspections by the facility's chief engineer, deputy commander, and commander, respectively.

There is no way of knowing if the procedures Handler describes are routinely implemented, or if they represent a model that has yet to be achieved. Based on the state of physical protection and material control systems at other Russian installations where weapon-grade nuclear material is handled, the latter interpretation seems more plausible.

Even if the procedures Handler describes are followed at some of the storage sites, safeguards may be undermined by inadequate equipment. For example, the plastic seals typically used in Russia do not meet international standards and cannot guarantee timely detection of diversion. According to Northern Fleet investigator Kulik, it would take no more than seven minutes to remove and reaffix the kind of seal used at Sevmorput.

In contrast, the physical security system at a typical U.S. facility with weapon-grade material includes a

perimeter enclosed by two razor-ribbon fences, with a cleared space between the fences controlled by intrusion-detection sensors and closed-circuit television cameras. Behind the fences is a vehicle barrier. The storage building itself is a structure with hardened walls and interior intrusion-detection sensors. The site is guarded by more than 60 armed security guards and has an on-site tactical response team.[6]

Nuclear facilities in Russia are supposed to have a protected site perimeter, a facility perimeter, and a guard force. In practice, however, physical security at nuclear sites is often undermined by both financial constraints and by the Soviet design philosophy. According to Gosatomnadzor, the Russian nuclear regulatory body, physical security at nuclear facilities in both the civilian and defense sectors suffers from a design philosophy that attached low priority to protecting the storage building itself. Russian physical protection systems generally lack intrusion-detection devices and portal monitors that are operational. In the case of the Sevmorput theft, for example, the alarm connecting the storage building to the guard post did not work because its fixtures had rusted and it had never been repaired.[7]

Gosatomnadzor has also criticized existing physical protection systems because they are not designed to address the threat of terrorist attack. Guards have inadequate protection (no bunkers or bulletproof guard posts); no vehicle barriers surround the facility; communications between on-site guards and off-site personnel is primitive at best; and the qualifications of many guards are suspect—a condition that is unfortunate but understandable, given the low wages and the irregular payment of salaries.

Although the United States has been slow to adopt some anti-terrorist nuclear protection measures, the presence of basic measures at U.S. nuclear facilities and their absence in Russia may be explained by the rapid economic, political, and social transformation of Russia. Previously, the extraordinarily centralized state with pervasive internal security measures made the threat of nuclear terrorism virtually non-existent. The lack of a domestic market value for nuclear material also eliminated the incentive for nuclear theft.

Equally, while one should not exaggerate the threat of nuclear diversion in Russia today, it should be recognized that the threat has arisen because of the general disintegration of central authority and the rise in ethnic tension and organized violence. Given the ease with which the Sevmorput storage building was penetrated, one must be concerned about the vulnerability of naval fuel sites to terrorist-minded groups.

The Sevmorput case also highlights the difficulty of guarding against the "insider threat," which represents the greatest security danger, according to Russian nuclear safeguards officials. The Soviet system of safeguards traditionally emphasized "personal responsibility," but the current crisis in Russia has eroded human reliability. A combination of factors— the end of the Cold War, the accident at Chernobyl, the contraction of the Russian defense and nuclear power sectors, and the inability of the state to subsidize previously privileged workers in the nuclear industry and the military—has resulted in tremendous economic and social upheaval. Moral standards have eroded. As a consequence, the primary threat to nuclear safeguards in Russia today is a knowledgeable and corrupt insider (or group of insiders) who have access to nuclear materials and may attempt to steal them for profit, for political reasons, or because they are coerced by a criminal organization.

In addition to the theft at Sevmorput, two other cases fit the insider profile: a 1992 diversion of 1.5 kilograms of weapon-grade uranium from the Luch plant at Podolsk, and the 1994 theft of 8 kilograms of low-enriched uranium fuel pellets from the Ignalina nuclear power plant in Lithuania—the same plant that was the target of a November 1994 bomb threat by organized crime.

Russian naval fuel safeguards are also compromised by confused lines of authority in material protection, control, and accounting systems. At least six government bodies—Minatom,

the navy, the State Committee for the Defense Industry (Goskomoboronprom), the transportation ministry, the Federal Counterintelligence Service (FSK), and Gosatomnadzor— have some responsibility at one time or another for shipping, storing, and safeguarding fresh naval fuel.

In theory, custody of most of the fuel passes from Minatom to either the navy or to the Shipbuilding Directorate of the State Committee for the Defense Industry as the fuel moves from the Elektrostal fuel-fabrication plant near Moscow to the central fuel storage sites, and from there to the navy's floating refueling maintenance ships (*plavuchaya masterskaya*, or PMs). Reportedly, during rail transport from Elektrostal, Minatom and regional offices of the FSK are responsible for protecting the fuel. In the case of fuel for the icebreakers, Minatom retains custody until the material arrives at the Murmansk Shipping Company and its Atomflot facility. At that point, presumably, custody passes to the shipping company, which, although partly privatized, is still technically subordinate to the transportation ministry.

After 1992, when the shipbuilding ministry was disbanded, some of the shipyards that house the fuel storage sites have been controlled by the Shipbuilding Directorate of the State Committee for the Defense Industry. There is conflicting information about whether different bodies within the State Committee actively exercise that custody. It is also unclear when custody passes to the navy, especially to the Northern Fleet.

Regardless of formal custody agreements, it appears that, for practical purposes, the individual shipyards are increasingly independent and that the State Committee exercises only indirect administrative responsibility. As at most other sites where nuclear material is present, the chief preoccupation of management these days is economic survival, not safeguarding fuel stocks.

Compounding the problem is the navy's reluctance to cooperate fully with Gosatomnadzor, which has responsibility for oversight of physical protection and material control in both the civilian and military sectors. In 1994, that nuclear regulatory body was denied access to naval nuclear facilities, and it was also excluded from the investigation of the theft at Sevmorput. Reportedly, access was limited because of navy resistance to what was perceived as undue intrusion by another organization, and because naval officers were concerned that Gosatomnadzor would discover something amiss, if not missing.

There is good reason for concern. The theft of fuel assemblies at Sevmorput was not the first. Several fuel assemblies were stolen from the Zapadnaya Litsa storage site in 1992. In addition, analyses of the small quantity of highly enriched uranium (800 milligrams) recovered in Landshut, Germany, in mid-June 1994, and the much larger amount (2.7 kilograms) seized in Czechoslovakia last December, suggest that the source of these smuggled stocks was naval fuel. (See "Which Fissile Fingerprint?" by Mark Hibbs, page 10.)

A safer system

Despite the shortcomings in Russia's civilian nuclear sector, many in the West assume that physical security remains high at Russian military installations, including storage areas for naval fuel. This belief, and the mistaken notion that Russian submarines are fueled with low-enriched uranium, have meant that little attention has been paid to naval fuel as a proliferation problem. This is unfortunate, given the ease with which security was breached at Sevmorput, and indications that at least some Russian submarine fuel is highly enriched uranium that could be readily converted to nuclear explosives. Western countries should consider helping to increase security at naval fuel-storage facilities.

Recent U.S. experience suggests that significant improvements in safeguarding Russian naval fuel could be achieved in a short period of time and at moderate cost. As a first step, the existing stocks of fuel should be inventoried and consolidated in a small number of secure facilities. The safeguards system need not be very sophisticated, particularly in comparison to bulk handling facilities. The material control and accounting measures, and the necessary physical security improvements, are well within the technical capabilities of Russian safeguards authorities.

The United States has already taken measures to assist Minatom and the Kurchatov Institute in upgrading security at selected facilities that house weapon-grade material. The equipment requirements—similar to those recently introduced at the Kurchatov Institute in Moscow as part of a "lab-to-lab" program of cooperative material protection, control, and accountancy—would include fences, reinforced buildings and doors, access-control equipment, intrusion-detection devices, and upgraded guard posts.

At the time of this writing, Alexei Tikhomirov, Dmitry Tikhomirov, and Oleg Baranov were standing trial in Murmansk for their involvement in the theft of naval reactor fuel from the Sevmorput shipyard. The hole in the fence that Alexei Tikhomirov climbed through to gain entry to the storage facility is said to be patched shut. But the underlying gaps in the Russian safeguards system remain. ■

1. This estimate is based on the assumption that the quantity of uranium per assembly is similar to that known to be used in the VM-4-AM reactor core. It also assumes that one would need about 12 kilograms of weapon-grade uranium to produce an implosion-type nuclear device.

2. According to the International Institute for Strategic Studies' *Military Balance 1994–1995* (London: Brassey's, 1994, pp. 116–117), 75 nuclear submarines remain operational in the Northern Fleet, and 34 in the Pacific Fleet. *Jane's Fighting Ships 1994–1995* (London: Jane's Information Group, 1994), p. 528, puts the numbers at 79 nuclear submarines in the Northern Fleet and 44 in the Pacific Fleet. Joshua Handler suggests that the actual number of operational submarines is lower still ("Greenpeace Trip Report," Greenpeace International, Washington, D.C., October 27, 1994, p. 6).

3. Handler, ibid.

4. Interview with Mikhail Kulik, *Yaderniy Kontrol*, January 1995, pp. 12–13.

5. Ibid.; personal correspondence with Russian journalist Vladimir Orlov, January 24, 1995.

6. Norman Brandon, "Elements of a HEU Process Infrastructure," presentation at the National Energy Institute's International Uranium Fuel Seminar, Beaver Creek, Colorado, September 25–28, 1994. (Brandon is a senior project director at Nuclear Fuel Services, Inc.).

7. Victor Litovkin, "Blown Up by Pilfered Uranium," *Izvestia*, July 17, 1994 (cited by Handler).

TOP GUNS

By ALEKSANDR GOLOVKOV and SERGEI LESKOV

Who's who in Russia's military; a scorecard for future maneuvering, power plays, and skirmishes.

LIPRECHTMANN

Gen. Matvei Burlakov (left), commander of Russia's troops in Germany, was joined by Defense Minister Pavel Grachev for the farewell ceremonies last September.

Early this year a scandal broke out in the Russian army the likes of which could not have been imagined—even in one's worst nightmare—only a few years ago. Gen. Vladimir Gladyshev, the commander of the Russian military base in Georgia, openly accused the Russian troops in the Caucasus and their commander, Fyodor Reut, of plundering army property and selling weapons to insurgents.

True, it takes no special genius to know that the Russian troops stationed in the region have become major suppliers of weapons to the area's numerous combatants, including the noisiest among them, the rebels in Chechnya. But saying so publicly is another matter.

The Defense Ministry has been conducting one investigation after another in the Transcaucasus. The task is especially difficult—not only do the

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AP/WIDE WORLD

Gen. Boris Gromov was brought back into the Defense Ministry in 1992, but had to leave again this year when he criticized the campaign in Chechnya and the appointment of Burlakov as a deputy minister.

ministry's inspectors have to find the truth, they also want to make sure that there will be no future airings of the army's dirty laundry.

This unprecedented scandal is just one of many jolts the Russian army continues to experience. In 1991 and 1992, the Soviet military machine was battered by a series of shocks as the Russian state was restructured. Disintegration was avoided, and most Soviet armed forces were transferred to the Russian Federation. But the continuing financial crisis and the wrangling of its leaders continue to weaken the now-Russian military. The sounds coming from what was once the most powerful army in the world are, at times, like a consumptive's rattling cough.

Since 1991, new political crises have pushed Russia's top military leaders into the political arena. At the Defense Ministry, the result has been a game of musical chairs, with deputy ministers going—and sometimes coming back—at short notice. The controversial and disastrous campaign in Chechnya is the latest crisis to rock the military command. A weakened Pavel Grachev still clings to the post of Minister of Defense, but how much power he retains is hard to say.

The chief of the General Staff has taken over the operation in Chechnya, the Tajik border patrol is managed by an independent command that reports directly to the president, and Grachev has been unable to control the actions of regional commanders in the newly independent republics. It is conceivable that Grachev now leads only supply and training.

In May 1992, when **Pavel Grachev** was appointed Minister of Defense, it appeared that he could pull the leading faction in the high military command more closely together. This group was already bound together by informal ties forged during the Afghan war. Grachev named his "elder Afghanistan comrades," Boris Gromov and Georgi Kondratiev, deputy ministers.

Grachev, who served two terms in Afghanistan (from 1981 to 1983 and from 1985 to 1987), was awarded the title of Hero of the Soviet Union and was named commander of the paratrooper division. In January 1991 he was appointed commander of the Airborne Troops, which were always considered the elite Soviet forces and the backbone of the Soviet regime.

Nevertheless, under Grachev, the paratroopers played a decisive role in support of the Russian democrats during the abortive coup attempt against Mikhail Gorbachev. Grachev had already established a close relationship with the new leaders, including Boris Yeltsin, when his loyalty and that of the Airborne Troops helped to assure the failure of the August 1991 coup.

Grachev has continued to demonstrate his loyalty to the new order, supporting Yeltsin during the crises of March and October 1993. As a result, he has become extremely unpopular with the army and society as a whole, and his career seems entirely dependent on the political longevity of the current president. The disastrous prosecution of the war in Chechnya has further undermined his position.

One of Grachev's "elder comrades" is **Gen. Boris Gromov,** who was commander of the troops in Afghanistan from 1987 to 1989. Gromov conducted a series of successful combat missions, and he was also praised for his supervision of the Russian withdrawal and efforts to minimize casualties. Gromov, generally regarded as the best military strategist in contemporary Russia, is the leader of an informal coalition of military men known as the "Afghan faction."

In 1990 and 1991, Gromov plunged into "big politics" as a people's deputy in the Supreme Soviet and as deputy to Boris Pugo, the minister of internal affairs. Pugo, one of the leaders of the August 1991 coup, later committed suicide.

Gromov ran for the office of vice president during the first Russian presidential elections. At about the same time his signature appeared (without his knowledge, he says) on the odious "Appeal to the People," a right-wing nationalist call for Russia to reject the democratic path.

Because he consistently opposed Yeltsin, Gromov was forced to resign from the military in 1991. But his influence with the army, especially with the middle ranks, remained. In the summer of 1992, when Grachev sought to strengthen the high command, he brought Gromov back as his first deputy.

After his return, Gromov distanced himself from political affairs, avoiding involvement in the events of 1993. But last year he was among the generals who spoke out against the appointment of Matvei Burlakov, the former commander of Russian troops in Germany, to the post of deputy minister of defense. Burlakov had been widely accused of corruption by the press.

When Gromov also criticized the military campaign in Chechnya, he again left the Defense Ministry. In February he was shifted to a mainly honorary position at the Ministry of Foreign Affairs.

Two months after Gromov's departure from the Defense Ministry, no one had yet dared to occupy his empty office. But it may not have been Gromov's ghost holding his fellow officers back. The legendary Marshal Georgi Zhukov, famous for his many World War II victories, once occupied the office. Many members of the military believe that to sit in the marshal's chair is an act of extreme immodesty.

Gromov is frequently accused of immeasurable ambition and conceit. Many believe that his goal is not so much to serve the army or the state as it is to be minister of defense. It is said that General Gromov's major interest in recent years has been attending receptions in the Kremlin and at various foreign embassies.

As long as the current leaders of the country remain in power, Gromov cannot count on a position with real decision-making responsibility. But Gromov's influence with the army might be pivotal in a crisis. Gromov could become a member of a post-Yeltsin government—if it consists of so-called "patriotic" forces. At the same time, Gromov would not support an extremist like Vladimir Zhirinovsky.

Gen. Georgi Kondratiev was Gromov's first deputy in Afghanistan. He later commanded the troops in Turkmenistan, where he was in charge of settling a number of transnational conflicts. When he became one of Grachev's deputy ministers of defense in 1992, he was put in charge of peacekeeping missions. But his actions in the Transcaucasus in 1992 and 1993 in support of secessionist forces in Southern Ossetia and Abkhazia directly contradicted the official policy of the Defense Ministry, which was aimed at forging a friendly relationship with Georgia by recognizing its territorial integrity.

Kondratiev, like Gromov, spoke out against Burlakov's appointment and against the military action in Chechnya, and he was also removed from his position in February.

Kondratiev has always been "political"—not content with simply carrying out orders. When the time is right—during a crisis or a change in political regimes—he will undoubtedly strive for a position of power, either in the armed forces or in the civil government. And he can bring much to the table: his influence in military circles, especially in the Caucasus, and his talent in the military-political arts, honed by his experience in the tangled conflicts of the Transcaucasus.

Last fall, **Gen. Matvei Burlakov**, the last commander of the Russian army in Germany, was promoted to deputy minister by Grachev, despite widespread grumbling by the officers of the high command and the press, which wrote extensively about corrupt practices by Burlakov and the troops stationed in Germany. But the Burlakov appointment was part of Grachev's effort, after the events of October 1993, to slowly distance himself from the Afghan faction by bringing in leaders of the returning Western army.

At about the same time, Grachev was involved in power struggles with two maverick regional commanders. His conflict with Aleksandr Lebed, the commander of the 14th army, was at first kept quiet, but it eventually got wide play in the media. Grachev's power struggle with Andrei Nikolaev, the commander of the border troops in Tajikistan, was less "noisy" but equally serious. That disagreement concerned the operational command of peacekeeping forces in Tajikistan. In neither case was Grachev able to assert control.

Gen. Aleksandr Lebed served in Afghanistan in 1981 and 1982. He has been the most politically active general in the Russian army.

In August 1991, it was Lebed who, acting on Grachev's orders, took up a position near the White House. (He categorically denies the rumor that during the coup attempt he switched to the side of the plotters.)

In June 1992, Lebed assumed command of the 14th Army, which is stationed in the Pridnestrovie region of the now-independent Moldova. Lebed has repelled efforts by Moldovan leaders to take control of the region, and he has been praised for defending the Russian-speaking population from discrimination.

AP/WIDE WORLD

Gen. Aleksandr Lebed on Chechnya: "Russian regiments of boy-soldiers are at war with the people. And they are doomed."

Lebed has fought not only with the leaders of Moldova, but with the civilian government of Pridnestrovie, and with his own command. At the same time, Lebed has received a great deal of positive publicity. He has been portrayed in a series of publications and television programs as a patriot—honest, a bit crude, but intelligent. It seemed as if he was considered by some as a potential charismatic leader in "big politics."

When the campaign in Chechnya went bad, however, Lebed announced that he would take command of the troops—but only to supervise their withdrawal from Chechnya. This statement was widely viewed as neither serious nor worthy of a military leader or statesman. But it was seen as a move by a political intriguer. Since then, Lebed's popularity has plummeted, both with the public and within the military.

Gen. Andrei Nikolaev took command of the troops on the Tajik border in the fall of 1993, at a time when the Tajikistan-Afghanistan border was particularly tense. Despite Grachev's objections, under Nikolaev the command of the border troops has been transferred to a separate department

AP/WIDE WORLD

U.S. Defense Secretary William Perry (left) shakes hands with Andrei Kokoshin, the civilian contender in Russia's defense establishment.

that reports directly to the president of Russia.

Last fall, Nikolaev was considered a leading candidate to replace Grachev. According to some, Yeltsin himself was leaning toward his appointment. But rumor has it that Nikolaev refused the appointment.

Nikolaev is one of the most promising military men in Russia. Given the right circumstances, he could end up in a significant political position.

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By late last summer, members of the "Afghan faction" had gone their separate ways. But Grachev's attempts to remove his former allies from positions of power had been fruitless.

Then, with the Burlakov appointment and the war in Chechnya, the struggle among the Defense Ministry factions got louder, and the different camps came into plain view. There was Grachev's faction, and the Burlakov faction (supported by Grachev). In opposition was the Afghan faction, led by Gromov. Then there were the allies of Mikhail Kolesnikov, the Chief of the General Staff (although Kolesnikov struck a neutral pose). There was also a group that backed the civilian first deputy, Kokoshin.

During the heaviest fighting in Chechnya in December and January, Grachev's position looked so shaky that at times his resignation seemed unavoidable.

Gen. Mikhail Kolesnikov is a professional military man who has risen from a tank platoon leader to chief of the General Staff. As Grachev's leadership lost favor during the Chechen conflict, the role of the General Staff increased dramatically. A Kolesnikov protégé, Gen. Anatoli Kvashnin, was put in charge of the troops in Chechnya. At one point, there was even talk of moving the General Staff out of the Defense Ministry altogether and putting it under the direct command of the president. But Kolesnikov opposed the move.

Andrei Kokoshin, a Ph.D. in history and a member of the Russian Academy of Sciences, is an expert in national security and the first deputy minister of defense. Those who favor a radical restructuring of the armed forces along a Western model consider it vital for a civilian to hold the position of defense minister and they have on many occasions suggested Kokoshin for the job. His bargaining chip in the ministry is the personal support of the president.

During the height of the crisis over Chechnya, the idea of a two-man management team to head the Defense Ministry circulated in the higher echelons of power in Russia. Possible scenarios included Kokoshin as minister, with Kolesnikov as first deputy with wide powers, or Kokoshin as Kolesnikov's deputy on political issues.

The war in Chechnya, which has brought so many unpleasant surprises to Russia's leaders, drastically altered the balance of power in the highest military echelon. The situation forced the president to act, no matter how cautiously, to eliminate squabbling that the government could not afford and which threatened unacceptable consequences.

As soon as the first significant victories were achieved on the battlefield, Burlakov and Kondratiev, leaders of two of the competing factions, were removed from their posts. Because of Gromov's wide influence, he was not dismissed but moved to an honorary position in the Ministry of Foreign Affairs, thus removing him from the military command.

Even though the war revealed Grachev's incompetence, the issue of his replacement has been postponed for an indefinite period. Grachev's new deputies are Vladimir Churanov, the commander of the home front, and Anatoli Solomatin, the chief of military construction and housing. These appointments may indicate that Grachev's area of responsibility has been shifted to provision and training.

At the same time, the influence of Kolesnikov, the chief of the General Staff, has increased dramatically. His protégé, Anatoli Kvashnin, who was responsible for a turnaround in the military campaign in Chechnya, was recently appointed commander of the Northern Caucasus military region.

It appears that the situation in the upper reaches of the Russian military has stabilized, at least for the time being, and the threat of conflict spreading to regional military commands has been removed. Throughout the officer corps, most members demonstrated a high degree of professionalism during the Chechnyan crisis; protests against the campaign were not widely supported, and refusals to carry out orders—on moral or political grounds—were very rare.

At the same time, the level of discontent with living conditions and with current military policy remains high. This discontent guarantees fertile ground for a renewal of the old conflicts or the emergence of new ones. ■

Blacklisting Schweitzer

By LAWRENCE S. WITTNER

Thanks to the recent declassification of key government documents, the dimensions of a bitter conflict between Dr. Albert Schweitzer, the famed humanitarian, and the U.S. government are evident for the first time.

Albert Schweitzer—distinguished musician, philosopher, theologian—returned in 1924 to the jungles of Lambaréné, in French-ruled Gabon, where he had previously developed a hospital. Here, under the most difficult conditions, he worked selflessly as a physician, preaching his own brand of reverence for life. Although Schweitzer was never quite the saint that legend implied, millions of people believed he was.

By the mid-1950s, Schweitzer stood at the height of his worldwide renown. In December 1955, a Gallup poll among Americans found that Schweitzer was the fifth most admired man in the world. By the following year, his status had risen to fourth.[1]

Naturally, political leaders paid court to him. In January 1955, President Dwight Eisenhower sent greetings to Schweitzer on his 80th birthday. "Your spirit and work have been an example and inspiration to all of us," the president wrote in this message, which was also issued as a White House press release. Secretary of State John Foster Dulles told Schweitzer that his "contributions to the peoples of the world . . . are indelibly written into the annals of our civilization."[2]

Yet, as previously classified government documents reveal, within just a few years Schweitzer became *persona non grata* to U.S. officials, including Eisenhower and Dulles. Secretly convinced that he was an adherent of "the Communist line," they severed personal contacts with him, ordered his activities investigated by the FBI and the CIA, orchestrated rebuttals to his public statements, and discouraged his travel to the United States.

To millions, Albert Schweitzer was a saint. But to the Eisenhower crew, he was a dangerous nuisance.

Visit to Lambaréné

This dramatic reversal began innocently enough in late 1956 when Norman Cousins, editor of the *Saturday Review*, made plans to visit Schweitzer at Lambaréné, carrying with him yet another birthday greeting from Eisenhower. Behind this journey lay Schweitzer's London publishers and Emory Ross, a former missionary who headed the Schweitzer Fellowship, which subsidized the hospital at Lambaréné. They had convinced Cousins to fly to Schweitzer's jungle headquarters to see if he could rescue the aging missionary's unfinished manuscripts—parts of which hung on nails in his room—from the hazards of moisture, fire, and wandering goats.

Cousins, though, had an additional motive for his journey. Appalled by the nuclear arms race, he had championed nuclear disarmament, as well as world government. A man like Albert Schweitzer, Cousins reasoned, might be able to convince people of the perils posed to human survival by nuclear weapons.[3]

Visiting Schweitzer at Lambaréné in January 1957, Cousins initially broached the question of preserving the manuscripts, then plunged into a discussion of "existing world tensions in the context of . . . total destructive power." Schweitzer, he explained, was one of the few individuals who could reach a worldwide audience.

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The *Daily News* said Schweitzer had repeated "stale Communist propaganda."

"All my life I have carefully stayed away from making pronouncements on public matters," Schweitzer responded. "I have tried to relate myself to the problems of all humankind rather than to become involved in disputes between this or that group." Even so, as Schweitzer pondered the unprecedented perils of the nuclear era, as well as the great popular renown he enjoyed, he began to waver.[4]

Pausing briefly to inspect some baby goats bleating outside his bungalow, the doctor returned to suggest that "maybe the place to take hold is with the matter of nuclear testing." The issues involved were not complicated, and "the matter transcends the military interests of the testing nations. It is clearly in the human interest that the tests be stopped."

Cousins had suggested that Schweitzer call for a meeting of government leaders, but Schweitzer thought this "much too complicated." Instead, he would reach them, he later told Cousins with impish glee, through "Radio Oslo . . . the city of the Nobel Peace Prize!" Schweitzer had received this coveted award in 1952, and thereafter he remained on good terms with the Nobel Prize Commission and with Norwegian radio. Eventually, Schweitzer convinced the president of the commission, Gunnar Jahn, to read a message in Norwegian over Radio Oslo and to have English, French, German, and Russian translations broadcast thereafter.[5]

In this fashion, Schweitzer had his "Declaration of Conscience" read over Radio Oslo on April 23, 1957, and eventually broadcast in nations around the world. Pointing to the dangerous effects of radiation produced by the testing of nuclear weapons, Schweitzer warned that every additional nuclear explosion was "a catastrophe for the human race, a catastrophe that must be prevented."

To fail to consider the consequences of nuclear testing "would be a folly for which humanity would have to pay a terrible price," Schweitzer's message entreated. "We must muster the insight, the seriousness, and the courage to leave folly and to face reality." World statesmen were "telling one another again and again that they want nothing more than to reach an agreement to end the testing of atomic weapons." But why did they not come to an agreement? "The real reason is that in their own countries there is no public opinion asking for it." Conversely, "when public opinion has been created in the countries concerned and among all nations," then statesmen would "reach an agreement to stop the experiments." And this, in turn, "would be like the sunrays of hope which suffering humanity is longing for."[6]

Schweitzer's message, broadcast in 50 nations and covered by countless newspapers, helped catalyze the growing public uneasiness about the nuclear arms race into broad-scale popular resistance.

In Norway, some 225,000 people added their names to Schweitzer's declaration. In West Germany, the Bundestag asked the nuclear powers to suspend nuclear testing; soon thereafter, both the opposition Social Democrats and Free Democrats initiated a tumultuous campaign against the deployment of nuclear arms in that nation. In Holland, critics of nuclear testing formed an Albert Schweitzer Committee Against Nuclear Weapons.[7] In Great Britain, Bertrand Russell and other prominent intellectuals established the Campaign for Nuclear Disarmament. In Sweden, a protest campaign against nuclear weapons erupted and prominently featured Schweitzer's warnings.[8]

And so it went throughout much of the world—including the Soviet Union where, although dissident movements could not organize openly, prominent scientists like Andrei Sakharov, inspired by Schweitzer, secretly pressed the Soviet government to end nuclear testing.[9]

American unease

The reaction to Schweitzer's "Declaration of Conscience" was rather subdued in the United States. For reasons that remain obscure, no American radio station broadcast Schweitzer's message. The *Saturday Review* printed the declaration in full, but few other publications gave it much attention.[10]

Even among media that deigned to notice Schweitzer's statement, the response was not always favorable. The *New York Times* criticized his stand, while the New York *Daily News* attacked him frontally. In an editorial titled "Pull in Your Horns, Doc," the paper proclaimed itself "not impressed" by his "long-winded epistle." Schweitzer's message "repeated the stale Communist propaganda about how nuclear fall-out is a fearful danger" and "flouted the assurances of most nuclear scientists that fall-out from test explosions at the current rate is not dangerous at all." The newspaper suggested that readers "laugh off this Schweitzer manifesto."[11]

U.S. government officials, however, found it less amusing. Nuclear weapons were the core of the Eisenhower administration's national security policy. When, in 1956, Democratic presidential candidate Adlai Stevenson called for a halt to nuclear testing, Eisenhower and other administration officials scornfully dismissed the idea. Stopping nuclear testing, said Vice President Richard Nixon, would be "catastrophic nonsense." To compound the administration's problem, secret government

opinion polls on nuclear testing indicated overwhelming opposition to nuclear testing in numerous nations, including key NATO allies.[12]

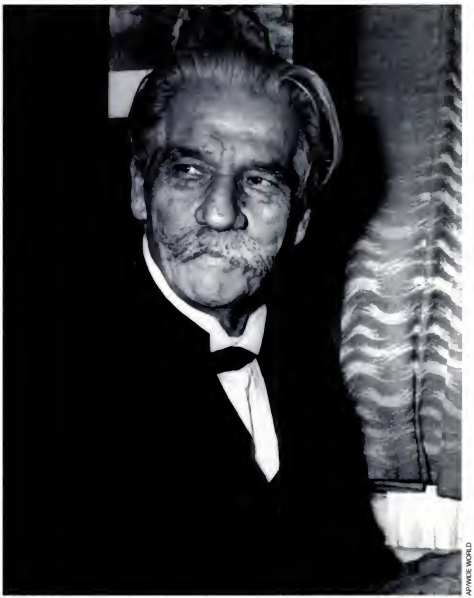
In this context, Schweitzer's declaration seriously exacerbated the administration's problems abroad and added to its difficulties at home. As Lewis Strauss, chair of the U.S. Atomic Energy Commission (AEC), complained to an AEC committee that spring, Schweitzer's appeal was "a body blow to the testing program."[13]

Naturally, then, from the standpoint of administration officials, everything possible had to be done to reduce the damaging effects of Schweitzer's message. Willard Libby, an AEC commissioner on whom Strauss leaned heavily when dealing with nuclear critics, prepared a rebuttal to Schweitzer that attracted far more attention in the United States than did the Declaration of Conscience. Carefully crafted and tactfully deferential to Schweitzer, it contrasted the "extremely small" risks from atmospheric nuclear testing with "the terrible risk of abandoning the defense effort which is so essential under present conditions to the survival of the Free World."[14]

Behind the scenes, the government response was less measured. In a memo to Libby dated April 26, 1957, Everett Holles, the AEC's public relations director, noted that Cousins had complained to CBS about the limited coverage given Schweitzer's declaration by the American mass media. "It is a curious coincidence," Holles observed acidly, "that the New York *Daily Worker* on Friday accused the radio-TV networks of 'suppressing' the Schweitzer story."

The memo makes it plain that the AEC must have played a role in CBS's decision to drop the issue. The network had asked if it could count on the AEC, including Libby, for cooperation if it decided to set aside time for a special program on the Schweitzer statement. Holles, however, declined to answer, stating only that "since Dr. Libby had made a respectful, scientific reply to Schweitzer I was not sure that he would want to carry on the matter over the air."[15]

Other U.S. government agencies also took up the Schweitzer case. That July, the CIA presented the State Department with copies of four letters Schweitzer had written to Gunnar Jahn and to Kaare Fostervoll, director of Radio Oslo, regarding the release of his appeal. The State Department later shared these letters with Strauss and other AEC officials.



AP/WIDE WORLD

Albert Schweitzer: Nuclear tests were a "folly for which humanity would have to pay a terrible price."

Given the CIA's subsequent refusal to declassify these letters or the accompanying memo, it remains unclear how the CIA obtained copies of Schweitzer's private correspondence. But Schweitzer believed that people—in his view, journalists—were tampering with his personal mail at the Lambaréné post office. Consequently, Schweitzer advised both Jahn and Fostervoll to address all correspondence pertaining to his antinuclear activities to a member of the hospital staff.[16]

More broadcasts

Despite the U.S. reaction, Schweitzer renewed efforts to arouse the conscience of the

U.S. officials searched zealously for evidence of Communist subversion.

world against the arms race. Dismayed by the heightened nuclear testing of the great powers—and by their soothing reassurances about radioactive fallout—Schweitzer arranged for three additional broadcasts on Radio Oslo in 1958. Aired on the evenings of April 28, 29, and 30 in Norwegian, and subsequently broadcast in other languages, these messages went further than his first. They called for an end to nuclear testing, nuclear weapons, and nuclear war.

"At this stage we have the choice of two risks," Schweitzer said in the final broadcast. "The one lies in continuing the mad atomic arms race, with its danger of an unavoidable atomic war in the near future; the other in the renunciation of nuclear weapons, and in the hope that America and the Soviet Union, and the peoples associated with them, will manage to live in peace."[17]

Broadcast around the world and published in an inexpensive format as *Peace or Atomic War?*, Schweitzer's new radio addresses intensified popular pressures for nuclear disarmament. American pacifists conducted non-violent invasions of U.S. missile bases and the U.S. nuclear testing zone in the Pacific. Large antinuclear marches swept through Japan. A Swiss Movement Against Atomic Armaments organized a massive campaign against the deployment of nuclear arms in Switzerland.[18] Modeling themselves on Britain's increasingly popular and rambunctious Campaign for Nuclear Disarmament, nuclear disarmament groups sprang up in New Zealand and Ireland. Gallup polls conducted in numerous cities outside the United States during May and June 1958 found their residents in favor of halting U.S. nuclear testing by 64 percent to 27 percent.[19]

Most embarrassing of all for U.S. officials was the fact that, on March 31, 1958—after completing a major series of nuclear tests—the Soviet government announced that it was suspending its nuclear testing program and urging the United States and Britain to do the same. Given the worldwide demand for an end to nuclear testing, as well as U.S. plans to conduct tests later that year, this was a brilliant move.[20]

In this context, U.S. officials viewed Schweitzer's radio broadcasts of late April 1958 as particularly villainous. Obtaining copies of Schweitzer's address a few days in advance of the broadcast, the U.S. ambassador to Norway, Frances Willis, claimed that it "generally supports [the] Soviet propaganda line."[21]

On May 2, Dulles reported that the Schweitzer talks had been "reviewed by interested agencies." Although it would "be unwise for government officials [to] answer Schweitzer directly," Dulles argued, private scientists should "challenge his remarks," perhaps in the *Bulletin of the Atomic Scientists*.

Back in Norway, the U.S. ambassador tried to find out if Schweitzer's broadcasts were ghost written. She reported May 12 that Schweitzer had sent Gunnar Jahn his talks "in manuscript form, hand-written in 'old-fashioned' German." Apparently, then, there were no foreign agents at work, just the determined, 83-year-old Schweitzer.[22]

Even so, U.S. officials searched zealously for evidence of Communist subversion or other malfeasance. On May 2, just two days after the broadcasts concluded, Strauss had the FBI launch an investigation of the Schweitzer Fellowship, the U.S.-based organization that had raised thousands of dollars over the years to maintain Schweitzer's hospital at Lambaréné. In three separate reports that must have disappointed Strauss, J. Edgar Hoover concluded that the fellowship was just what it purported to be: a charitable organization that funded humanitarian work, nothing more.[23]

Meanwhile, cognizant of Schweitzer's latest appeal but unaware of Washington's fierce disdain for him, the U.S. consul general in the Congo, James Green, reported in late May that he would be visiting Schweitzer in June. Would the State Department like him to "deliver greetings" from Eisenhower or Dulles or "summarize current thinking" on the suspension of nuclear testing? In response, Acting Secretary of State Christian Herter warned the diplomat that Schweitzer's articles and speeches had been highly critical of U.S. nuclear testing and had been "closely adhering [to the] Communist line."

"Your visit would probably not convince [the] aging Schweitzer [of] his error and might provide ammunition for [a] declaration [that a] United States official [was] trying [to] bring pressure [to] bear on him." Herter therefore advised Green to "exercise extreme caution and under . . . no circumstances discuss nuclear policy or disarmament." Furthermore, there would be "no message of greeting from [a] high United States official."[24]

Despite these admonitions, when Green visited Lambaréné in mid-June, he engaged in extensive discussions with Schweitzer about nuclear testing and nuclear weapons—discussions he justified by noting that Schweitzer introduced the subject. In these conversations, summarized in a five-page, single-spaced memo to the State Department, Green found Schweitzer "extraordinarily alert," eloquent, and quite sincere. When discussing the terrible effects upon nature produced by years of nuclear weapons explosions, tears came to the doctor's eyes, Green wrote. He concluded, unhappily, that "although the Department understandably resents the fact . . . that Dr. Schweitzer is giving support to the Communist line, it should not be concluded that Dr.

Schweitzer has any sympathy for Communism or any desire to support the Soviet Union against the Free World. On the contrary," Green argued, Schweitzer was "acting on the basis of deep humanitarian convictions. These convictions happen—unfortunately—to coincide with current Soviet policy."[25]

The moratorium

Ironically, U.S. nuclear policy was on its way to coinciding with Soviet policy, too. Embarrassed by years of antinuclear protests, dismayed by polls showing widespread hostility to U.S. nuclear weapons testing, and humiliated by the Soviet moratorium, U.S. officials shifted gears in the spring and summer of 1958. On April 8, Eisenhower secretly suggested halting the U.S. test program, arguing that "continued rigidness on nuclear testing may well lead to [the] moral isolation of the United States." In July, Dulles told a British official that "in face of public pressure," the United States "would have to suspend tests."[26]

Sensing the drift, hardliners within the administration met with Eisenhower on August 12 and pleaded with him to continue underground nuclear testing. But the president responded that world opinion could be even more powerful than nuclear weapons. On August 20, Dulles wrote British Prime Minister Harold Macmillan that "our standing in the world is at a point where there is real danger to us in being adjudged militaristic. That danger can have consequences as serious as the forgoing of some nuclear weapons knowledge." Finally, in late August, Eisenhower announced that the United States would suspend nuclear testing as of October 31, while the nuclear powers negotiated an effective inspection system.[27]

Schweitzer was overjoyed at the news. "I read it with deep emotion," he told Cousins. At last their efforts seemed crowned with success. "Our pact in Lambaréné," Schweitzer observed with some justification, "has surely contributed to the fact that the powers possessing atomic weapons had to give in."[28]

Remarkably, Schweitzer's emergence as a nuclear critic did not diminish his extraordinary public prestige. In late 1958, a Gallup poll found that, among Americans, his status had risen to the third most admired man in the world. He retained this standing in 1959 and 1960.[29]

Nevertheless, within the Eisenhower administration Schweitzer's opposition to nuclear weapon tests was not easily forgiven. At the outset of 1959, when a proposal surfaced to have Eisenhower send birthday greetings to the 84-year-old physician, Gen. Andrew Goodpaster of the White House staff vetoed the idea.

Soon after, Eisenhower had to deal with a request from Robert Goheen, president of Princeton University, that Eisenhower join him in inviting Schweitzer to the United States to accept an honorary doctorate at Princeton. Dulles admitted to the president that "humanitarian reasons" made such a visit

Upcoming Events

May 1–2
"Risks, Regulations, and Resolutions: Creating the Process," 2nd Annual Wildlands Conference sponsored by the WILDLIFE HABITAT COUNCIL, Hyatt Regency, Dearborn, MI; for more information call (301) 588-8994.

May 2–4
"Global Energy Future 1995," sponsored by the U.S. DEPARTMENT OF ENERGY and the NATIONAL TIMES, Columbia University, New York, NY; for more information call CCS Associates at (612) 949-2518.

May 4–5
"Korea and the Future of Northeast Asia: Conflict or Collaboration?" 6th Annual International Conference on Asia-Pacific affairs sponsored by PORTLAND STATE UNIVERSITY, Portland, OR; for more information call (503) 725-5859.

May 13–14
"The Arms Trade, Collective Security, and International Law," a general assembly of the INTERNATIONAL ASSOCIATION OF LAWYERS AGAINST NUCLEAR ARMS, Florence, Italy; for more information call (3170) 363-4484.

May 16–18
"Beyond Data: Practical Techniques for Communicating Risk," sponsored by LEONARD H. ROLLER, INC., Keystone Conference Center, Keystone, CO; for more information call (312) 988-7667.

May 24
"Education for Global Security," sponsored by the COMMISSION ON DISARMAMENT EDUCATION, Lehman College, Bronx, NY; for more information call (203) 255-4269.

May 26–30
"Working It Out: Creating Inclusive Social Structures," sponsored by the NATIONAL CONFERENCE ON PEACEMAKING AND CONFLICT RESOLUTION, Minneapolis, MN; for more information call (415) 552-8680.

June 19–22
"4th Annual International Conference on Controlling Arms," sponsored by the DEFENSE NUCLEAR AGENCY, Wyndham Franklin Plaza Hotel, Philadelphia, PA; for more information call (703) 550-6801.

Notices of conferences, seminars, and other events may be sent to Advertising Manager, *The Bulletin of the Atomic Scientists*, 6042 South Kimbark Avenue, Chicago, Illinois, 60637.

Kennedy had not faced Schweitzer's opposition to nuclear testing in the 1950s.

desirable. "On the other hand," he remarked, Schweitzer was "rather undependable politically." Dulles promised Eisenhower that he would have this matter "staffed" and then report back.[30]

The staff report, prepared by John A. Calhoun, a State Department official, could hardly have been more hostile. It informed General Goodpaster that "as you are aware, Dr. Schweitzer's articles and speeches have been highly critical of United States nuclear test policy and closely adhere to the Communist line." Calhoun concluded that, "in view of Dr. Schweitzer's dubious political attitudes, the Department does not believe that the President should join Dr. Goheen in inviting Dr. Schweitzer to visit this country."[31]

This recommendation prevailed. A letter to Goheen was drafted, rejecting Eisenhower's participation on the basis of "articles and speeches" by Schweitzer that "have been highly critical of certain aspects of U.S. policy." Ultimately, though, the final letter, dispatched by Eisenhower on March 10, avoided political issues entirely. Instead, it simply implied that a presidential invitation to "a foreign dignitary to accept an honorary degree in this country" would set a bad precedent. Although the Princeton president did send an invitation to Schweitzer, reinforced by appeals from Robert Oppenheimer and Adlai Stevenson, Schweitzer declined. In fact, he never again visited the United States.[32]

Schweitzer and Kennedy

Schweitzer had a somewhat less conflictual relationship with the new administration of John F. Kennedy. Unlike Eisenhower, Kennedy had not borne the burden of Schweitzer's opposition to nuclear testing in the 1950s.

Furthermore, in the fall of 1961, when the Soviet Union unilaterally broke the moratorium it had begun, Schweitzer's warnings about the dangers of nuclear testing served administration policy very well. Assailing the Soviet resumption of nuclear testing, the new president, joined by British Prime Minister Macmillan, urged Soviet Premier Nikita Khrushchev to follow their lead by agreeing "not to conduct nuclear tests which take place in the atmosphere and produce radioactive fallout." This would "protect mankind from the increasing hazards from atmospheric pollution and . . . contribute to the reduction of international tensions."

In a speech later that month to the U.N. General Assembly, Kennedy said that the U.S. and British governments had proposed a ban on atmospheric testing "to save the human race from the poison of radioactive fallout." The United States, he insisted, wanted "to halt the spread of these terrible weapons, to halt the contaminations of the air, [and] to halt the spiraling nuclear arms race."[33] U.S. officials had ceased to describe radiation from nuclear tests as harmless.

Of course, the Kennedy-Schweitzer relationship deteriorated somewhat as the government announced plans to resume atmospheric nuclear testing. Writing to Kennedy on April 20, 1962, Schweitzer reminded him of the dangers of radioactive fallout that would accompany atmospheric testing. Even the purportedly reduced fallout of the latest U.S. weapons "will still cause men and women of our generation to receive radiation through radioactive milk, radioactive vegetables, radioactive water, or in any other way. The smallest doses of radiation on the so sensitive cells of the reproductive organs are sufficient to cause the future misery in the third and fourth generations."

Five weeks later, after the resumption of U.S. atmospheric nuclear testing, Kennedy responded respectfully, if a bit tartly, in defense of his actions. "I can see no choice, as the man responsible for the future of my country and my people, but to take necessary steps to protect the security position of the United States."[34]

Eventually, however, Kennedy began new test ban negotiations that culminated in the summer of 1963 in the signing of the world's first nuclear arms control agreement—the Partial Test Ban Treaty. Here at last was the culmination of Schweitzer's efforts, and he reacted with exultation. On August 6, he wrote to Kennedy that the treaty was "one of the greatest events, perhaps the greatest, in the history of the world." This test ban treaty, he said, "gives me hope that war with atomic weapons between East and West can be avoided." Delighted with Schweitzer's message, the White House staff featured it in a press release issued at Hyannisport. Kennedy's secretary, Evelyn Lincoln, later observed that the arrival of Schweitzer's effusive letter created great excitement in the president's office and that Kennedy "was extremely grateful to him for his views."[35]

By the summer of 1963, then, the situation had turned full circle. Only recently considered an unregenerate adherent of "the Communist line," Schweitzer was once again regarded as a saintly, politically useful figure by the U.S. government. This reversal, of course, was not a result of any change in Schweitzer's opinions. In fact, he had been remarkably consistent in his critique of nuclear testing and the nuclear arms race. Rather, the renewed respect for Schweitzer among U.S. officials attested to how far they had shifted their position on nuclear weapons under the prodding of others, including the gentle doctor from Lambaréné. ■

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The rise and fall of Project Chariot

By PAUL BOYER

The Firecracker Boys
By Daniel T. O'Neill
St. Martin's Press, 1994
374 pages; $23.95

As the nuclear arms race recedes, or at least mutates into new forms, we learn more and more about the ways it polluted and poisoned the streams of our national life—both literally and figuratively. Dan O'Neill's absorbing new book *The Firecracker Boys* is a major contribution to this ongoing process of historical excavation. O'Neill, a research associate in the oral history program at the University of Alaska-Fairbanks, recreates in careful detail the story of Project Chariot, a bizarre plan gestated in the late 1950s at Lawrence Livermore National Laboratory. The plan called for the detonation of up to six thermonuclear bombs at a remote point near Cape Thompson on Alaska's coast, where the Ogotoruk Creek flows into the Chukchi Sea.

The initial public rationale offered for the plan was that the explosions could transform the mouth of this small stream into a major international harbor that would stimulate fabulous economic development, dramatically illustrate the peacetime uses of atomic energy, and provide a showpiece for the Eisenhower administration's Project Plowshare.

But the absurdity of the idea soon became apparent: The region, more than 100 miles north of the Arctic Circle, is icebound for months at a time, and access to the coal fields of the interior would have required the construction of prohibitively expensive rail facilities. When the hoped-for private investment that was a crucial component of the plan failed to materialize, a more general rationale for Project Chariot emerged: that the "experiment" would advance nuclear knowledge, and thus in some vague way promote human happiness and well-being.

O'Neill, an engaging writer as well as a careful researcher, begins his account with a description of Cape Thompson's history and ecology, and of the local Eskimo economy based on fishing and hunting. He then establishes the larger context of Project Chariot's origins. It was the brainchild of the Hungarian émigré physicist Edward Teller, whose fingerprints criss-cross so much of our nuclear history.

A Manhattan Project veteran and "Father of the H-bomb," Teller in 1952 had become head of the Lawrence Livermore nuclear weapons laboratory. In the late 1950s, as the hazards of radioactive fallout became increasingly apparent and a moratorium on nuclear tests began, Teller avidly embraced Atoms for Peace. If nuclear detonations ostensibly designed to explore the peaceful uses of atomic energy could be exempted from a possible future test-ban agreement, covert weapons research could proceed as well.

This, in turn, led Teller and his Livermore associates to a quest for monumental engineering projects that could theoretically be undertaken only with the aid of nuclear explosions. Touting the wonders of what he called "geographic engineering," Teller joked at one news conference: "If your mountain is not in the right place, drop us a postcard."

One high-visibility project that quickly surfaced was the idea of rearranging the Panama Canal by a series of blasts to eliminate the many locks, transforming the canal into a

sea-level waterway. Another was to bypass the Suez Canal by constructing an alternate canal across the Negev northward from the Gulf of Aqaba, wholly on Israeli territory. Project Chariot initially entered the picture as a preliminary step to lay the groundwork for these more visionary undertakings. Despite tensions between the freewheeling Teller and Atomic Energy Commission (AEC) officials back in Washington, the AEC under Lewis Strauss generally backed these plans.

The heavily publicized campaign to explore the "peacetime uses" of atomic energy served a broader purpose as well. As the Livermore scientist (and future defense secretary) Harold Brown wrote in a classified 1957 report, dramatic demonstrations of the engineering application of nuclear explosions would help Americans "gain a more rational viewpoint" about nuclear issues by countering the "phobic public reactions [that] have been built around nuclear bombs."

Thus it was that Edward Teller, the quintessential nuclear-age snake-oil salesman, arrived in Alaska on July 14, 1958, to promote Project Chariot. Initially, he enjoyed remarkable success. O'Neill documents the symbiotic convergence of interests that arose between Teller and other proponents of nuclear-weapons development, on the one hand, and local groups in Alaska, on the other. The region's politicians, major newspapers, business groups, and would-be developers quickly fell into line. So, too, did the University of Alaska at Fairbanks and its entrepreneurial president, William Ransom Wood, a latter-day incarnation of the buccaneering "Captains of Erudition" so hilariously skewered in 1918 by Thorstein Veblen in *The Higher Learning in America*.

When university biologists called for studies of the environmental implications of turning Alaska into a nuclear test site, and the AEC compliantly agreed to fund those studies, dollar signs began to dance in the eyes of university officials. Soon AEC research grants were flowing to Fairbanks. The total eventually was more than $100,000.

Cementing its profitable link with the AEC, the University of Alaska in 1959 awarded Teller an honorary degree. In his commencement address, Teller spoke enthusiastically of the "industry and progress" that Project Chariot would bring to Alaska, and added grandly (if ungrammatically): "Please God, that by making harbors here in Alaska, perhaps near coal deposits, by exporting this coal cheaper to Japan, the Japanese might become the first beneficiaries of atomic explosions as they have been the first victims."

But tensions within the university quickly arose. On one side were Wood and other administrators eager to maintain a lucrative relationship with the AEC. On the other were the field researchers intent on documenting and publicizing the potentially devastating impact of the proposed detonations on the Cape Thompson ecosystem and on the livelihood of the local Eskimos. O'Neill records in ample detail the academic infighting that ensued as university officials pressured researchers to modify their findings; censored and rewrote reports; and eventually forced out two university staff members who refused to kowtow, William O. Pruitt and Leslie Viereck.

Shabby as it is, the story will hardly shock anyone familiar with academic politics and the ways of university administrators. But unlike many such tales, *The Firecracker Boys* has a qualified happy ending. Pruitt and Viereck, the troublesome researchers who lost their jobs, not only pursued productive careers elsewhere despite attempted blacklisting by the AEC, but in 1993 both returned to the University of Alaska-Fairbanks to receive honorary degrees. Faculty members with long memories initiated this belated effort to right an old wrong—and they overrode efforts by administrators to substitute bland generalities in the degree citations for an explicit acknowledgment of the events that occurred nearly 30 years before.

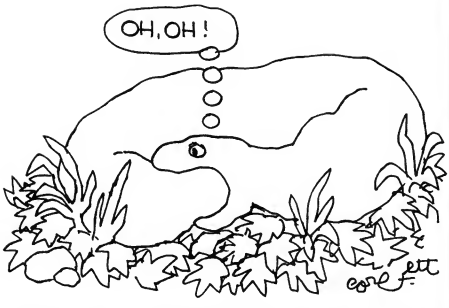
On a larger canvas, the happy ending also includes the fact that Project Chariot quietly expired, done in by its own inherent flaws, by shifting political winds in Washington, and by an increasingly articulate and confident local opposition. Slowly, but with growing effectiveness, some Alaskans began to protest and to mobilize. The Eskimos of Point Hope, a settlement some 30 miles north of the proposed detonation site, displayed sophistication, worldly knowledge, and media savvy that repeatedly flummoxed patronizing AEC officials. (At one meeting, an AEC spokesman, facing questions far beyond his depth, made a series of patently false assertions—all captured on tape by the Point Hope residents.)

As the environmental researchers, working under rigorous conditions in a frigid Arctic setting, painstakingly compiled and publicized their data despite the efforts of University of Alaska administrators to muzzle them, the national media eventually began to pay attention. Stories appeared in the *New York Times*, *Outdoor Life*, *Harper's*, the *Christian Science Monitor*, *The Bulletin of the Atomic Scientists* (December 1961), and many other publications.

Advocacy groups from the Sierra Club to the Association on American Indian Affairs became involved. In St. Louis, Barry Commoner's Committee for Nuclear Information spread word of the danger. And with the election of John F. Kennedy in November 1960, the political climate in Washington turned distinctly chilly toward Teller and his allies. Interior Secretary Stewart Udall forcefully intervened, making clear that in his view Project Chariot would violate longstanding Eskimo land rights.

By 1962, the AEC and Livermore officials were looking for ways to quietly scuttle the $4 million project that had become a public-relations albatross. That August, Livermore lamely announced that since other tests had provided the information they had hoped to glean from the Alaska blasts, Project Chariot would be "held in abeyance." Despite the qualified nature of the statement, opponents rightly celebrated: The scheme was dead.

The author's exemplary case study of the politics of nuclear-weapons testing in the late 1950s and early 1960s illustrates some central features of this bleak era in America's Cold War history. For example, O'Neill amply documents the duplicity of the AEC and Livermore officials. In public statements they insisted that every effort would be made to keep the radioactive fallout from Project Chariot to a minimum, and to



time the detonations so that the radioactive debris would drift seaward rather than onto the land.

But internal documents O'Neill uncovered make clear that one purpose of the test was to study the effects of radiation on the ecosystem of the tundra—implicitly including the human population. When a Livermore study group in 1961 explored the possibility of reducing the yield of the detonations, for example, one *disadvantage* they listed was that smaller explosions would reduce radioactive fallout, thus diminishing the usefulness of the experiment.

O'Neill also documents the way the AEC manipulated research grants to achieve the results it wanted. When AEC-funded biologists, botanists, and geographers working on the site produced draft reports that underscored the environmental dangers and uncertainties of Project Chariot, the AEC threatened to withhold payments to the University of Alaska until "satisfactory" results were forthcoming, rousing consternation in President Wood's office.

Behind the pose of supporting unbiased scientific research on the project's ecological impact, AEC/Livermore officials from the start focused mainly on public relations, as they subtly and not-so-subtly pressured scientists to produce reassuring studies that would allay public fears and clear the way for the test. O'Neill makes clear how readily university administrators, concerned primarily with maintaining the flow of research dollars to their campus, collaborated in this process.

The Firecracker Boys also reveals that the attempts at PR manipulation and cover-up continued long after Project Chariot was all-but-forgotten. Edward Teller, the Energizer Bunny of America's nuclear-weapons program, became so enraged by O'Neill's questions in their interview for the book that, according to O'Neill, he halted the session, berated O'Neill with a stream of vituperative invective, and melodramatically tore up the release form he had earlier signed.

The CIA also stonewalled O'Neill, refusing his Freedom of Information Act request for its file on one of the young scientists who had been most critical of Project Chariot, geographer Don Foote, even though Foote died in 1969 following an automobile accident. (Apparently, as in the Karen Silkwood case, some of Foote's friends found his death suspicious, but O'Neill—invariably balanced and judicious—does not endorse conspiracy theories in the case.)

And his story has a disturbing coda. O'Neill's research in the Livermore records turned up the fact that in August 1962, even as Project Chariot was expiring, government scientists working under contract with the AEC secretly brought to the proposed test site on Ogotoruk Creek 43.5 pounds of highly radioactive sand from a nuclear test conducted in Nevada earlier that summer. They placed this material at various sites along the creek "to determine the extent to which water passing through irradiated soil would dissolve the fallout radionuclides and transport them to aquifers, streams and ponds."

After the experiment, the scientists gathered some 15,000 pounds of contaminated soil into a low mound, bulldozed uncontaminated soil over it, and quietly departed without posting a warning or informing local officials of what they had done. O'Neill's 1992 revelation of this long-suppressed episode led to a wave of fear and anger among the long-suffering Eskimos of Point Hope, some of whom drew a link between the experiment and the high rate of cancer deaths in their community. (Public-health experts believe that diet, cigarette smoking, and other non-radiological factors are the more likely causes—but the people of Point Hope have a well developed skepticism toward experts.)

Apart from stonewalling by the CIA and Teller, O'Neill faced other roadblocks in getting his story out. He initially planned to produce a program about Project Chariot for Alaska public television, which is based at the University of Alaska-Fairbanks. Although he secured funding from the Alaska Humanities Forum, Alaska public-TV officials got cold feet and canceled the project. It might jeopardize their funding, they feared, by alienating university bureaucrats and especially ex-president Wood, still a formidable figure on the local scene. Like the environmental researchers he writes about, O'Neill has shown considerable persistence, ingenuity, and courage in telling a story that influential individuals and institutions would rather keep quiet.

O'Neill documents in illuminating detail the process by which that elusive phenomenon, "grassroots protest," actually arises and is mobilized. He recreates the texture and feel of tense meetings in the crowded Point Hope town hall, of biologists and geographers slowly coming together to oppose the juggernaut of powerful interests behind Project Chariot, and of the process by which the issue was picked up and publicized by the na-

tional media. (An Episcopal priest in Point Hope with good contacts among the East Coast elite played an important role.)

The book also shows how this seemingly isolated episode contributed significantly to the emergence of a larger environmental consciousness in Alaska and beyond, and to a broader awareness among Alaska's Native American population of their legal rights and the need to stand up for those rights. When the Alaskan press proved supine and uncritical in its enthusiasm for Project Chariot, for example, the Eskimos of Point Hope took steps to launch their own newspaper, the *Tundra Times*.

The Firecracker Boys rests on solid research. O'Neill accumulated a massive archive of print material and unpublished records, and he conducted oral-history interviews with many of the surviving participants. Though his own sympathies are clear, he makes every effort to present fairly the motivations and actions of all participants, even those whose behavior seems most indefensible.

This book, in short, is an important addition to a growing shelf of case studies that present a disturbing picture of the way government authorities, under the justification of defending the nation against "the Soviet threat," seriously damaged the fabric of American democracy. Books such as this remind us of the manifold dangers that arise when scientific hubris, ideological compulsions, governmental power, and public-relations manipulation converge behind misconceived "projects" that in retrospect are profoundly dangerous to the public weal.

Of course, as historian Alan Brinkley has reminded us, we must guard against the populist fallacy of assuming that "the people" are invariably wiser than those in positions of power and influence. But as one surveys the half-century history of U.S. nuclear-weapon research and testing, one can hardly avoid the conclusion that time and again it was "the people," or at least local groups of politically attentive citizens, who proved wiser and more responsible than the experts. ■

Paul Boyer, the Merle Curti Professor of History at the University of Wisconsin-Madison, is the author of By the Bomb's Early Light: American Thought and Culture at the Dawn of the Atomic Age *(reissued in 1994).*

No thanks to Reagan

The Great Transition: American-Soviet Relations and the End of the Cold War
By Raymond L. Garthoff
Brookings Institution, 1994
834 pages; $44.95

WALTER C. UHLER

Raymond Garthoff, a senior fellow at the Brookings Institution, has written the definitive study of American-Soviet relations during the 1980s. It blames President Reagan and the ideologues in his administration for the deterioration of relations during his first term, and credits their unprecedented military expenditures for little more than contributing "mightily to the mountain of national debt." *The Great Transition* quite accurately credits the bold, visionary policies of Mikhail Gorbachev for terminating the arms race and ending the Cold War. Garthoff's exhaustive support for such conclusions renders them nearly incontrovertible.

Although Garthoff reserves his severest criticism for the ideologues on Reagan's security team—especially Caspar Weinberger, who the author asserts "was unabashedly selective with the 'facts'"—one of the most revealing events of the early years of Reagan's presidency concerned the comparatively moderate Secretary of State, Alexander Haig. Haig was puzzled to learn that his public denunciations of the Soviet Union's support for terrorism were not supported by the data gathered by U.S. intelligence agencies. He had, after all, read advance proofs of Clair Sterling's book, *The Terror Network*, and received confirmation from neoconservative Michael Ledeen that the Soviet Union sponsored terror around the world.

When the matter was investigated, Haig and CIA Director William Casey discovered that the CIA had supplied "concocted misinformation" to Sterling. Haig, Sterling, and presumably many Americans were duped by this CIA disinformation. Worse still, in an early draft of the new intelligence estimate requested by Haig, the CIA actually had concluded that "the Soviets have opposed international terrorist activity in public and, in private, have urged their own clients to avoid its use." That uncongenial assessment did not, however, find its way into the estimate ultimately approved by the Reagan administration. Instead, an assessment more in keeping with its preconceived Cold Warrior ideology became the official one.

In other instances, assertions as outrageous as Haig's were based upon exaggerated intelligence estimates, few of which were publicly corrected even after they had generated the desired appropriations for specific weapons. It was Reagan's "notorious disregard of concrete facts" that fostered an atmosphere in which virtually anything could be said, provided it was ideologically correct. As America would soon learn—with Oliver North,

"All right now—let's see who can be the least competitive."

REX F. MAY

Elliot Abrams, and the Iran-contra scandal—virtually anything could be done in the name of Cold War national security. These matters are of no small importance, given that Reagan accused the Soviet Union of reserving "unto themselves the right to commit any crime, to lie, to cheat" to achieve their objectives.

Although the irresponsible rhetoric did persuade Americans to accept massive defense expenditures, Garthoff searches in vain for any positive impact on the Soviet gerontocracy. He concludes that, during the last two years of Leonid Brezhnev's rule (1981–82), the Soviets gradually shifted from a wait-and-see attitude to one that found Brezhnev engaging in an extraordinary meeting on October 27, 1982, to mollify his military establishment. The latter's public criticism of Brezhnev's inadequate defense expenditures and policies caused a crisis in military-civil relations.

Brezhnev had slowed the growth of defense spending years before Reagan became president. As Garthoff notes, "Soviet defense outlays had fallen from the 4 to 5 percent a year real increases of the early 1970s to an average 2 percent increase [from 1976 to 1981]." Soviet procurement of weapons was virtually flat during this period. When this information was provided to Reagan's security staff in 1983, however, they simply ignored it and moved on to other justifications for defense spending.

Despite Yuri Andropov's slight retreat from his predecessor's increasingly hard line, tension reached its peak during 1983. Reagan's "evil empire" and "Star Wars" speeches in March were but mere code words, in the Soviet mind, for imperialistic and nuclear first-strike aspirations. During 1983, Soviet intelligence agents operating in the United States and Western Europe, who had been placed on extraordinary alert (Operation RYAN) from May 1981 until late 1984 for indications of an American nuclear attack, were being arrested and expelled in droves. On August 31, a Soviet fighter intentionally downed Korean Air Lines flight 007—thinking it was an American military reconnaissance plane—when it entered Soviet airspace. All of the 269 passengers perished.

In late September, Andropov issued a sobering statement accusing the "current U.S. administration" of constituting "a serious threat to peace." In October the United States invaded Grenada. In November it took part in a NATO exercise (Able Archer 83) which prompted the Moscow KGB "Center" to issue flash telegrams calling for information about an imminent nuclear attack on the Soviet Union. This matter sobered Reagan and "contributed to his desire for face-to-face contact with Soviet leaders." By the end of the year, the Soviets had walked out of negotiations on Intermediate-Range Nuclear Forces (INF) and Strategic Arms Reduction treaties.

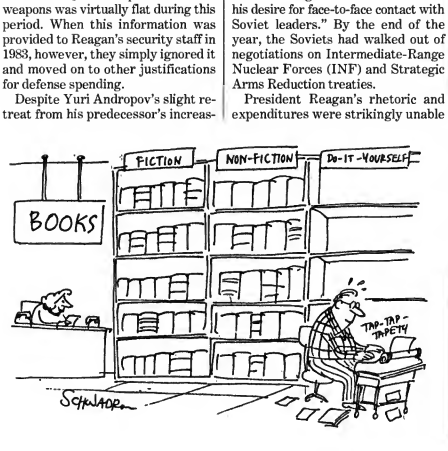
President Reagan's rhetoric and expenditures were strikingly unable to force concessions from three successive gerontocrats (Brezhnev, Andropov, and Chernenko). Garthoff even questions whether Reagan actually achieved a military buildup or merely produced a "major increase in military expenditures"—as was certainly the case with Star Wars.

In any case, "the Soviet leaders did not change their military effort to match it; indeed they continued a lower level of military buildup, which an intelligence reassessment in 1983 showed had begun in 1975–76." The author continues: "There was a modest increase from 1985 through 1988 [which, nevertheless] . . . remained far below the Soviet rate of buildup before 1976." So much, then, for the interpretation that credits the Reagan administration for bankrupting the Soviet Union.

While Reagan continued in this rut, a much younger Mikhail Gorbachev was struck by the exorbitant cost and decreased security that accompanied the militarization of relations. In power less than a year when the 27th Congress of the Soviet Communist Party met in February 1986, Gorbachev already was denying "that any country could find security in military power, either for defense or deterrence. Security . . . could only be found through political means, and only on a mutual basis." Even today these ideas sound revolutionary, if not utopian. But Gorbachev's bold leadership brought them to fruition—and ended the Cold War.

President Reagan and most Americans, however, preferred to believe that America's military power had compelled Gorbachev to make concessions, even after Gorbachev repeatedly took "the initiative to go beyond American positions, to make greater sacrifices of Soviet military advantages than those called for by the United States, both in unilateral actions and in pushing the United States to go further in negotiations."

In reality, Gorbachev's new thinking had to overcome the "obsolete zero-sum negotiating mode" of the Americans. "Rather than facilitating Gorbachev's revolution by cooperation, the Reagan and Bush administrations made the task more difficult by such tactics, before eventually welcoming the result they had wanted but had done so little to bring



about." With that conclusion, Garthoff's exemplary scholarship places the credit for ending the arms race and Cold War where it belongs. ■

Walter C. Uhler is chief of financial services at the Defense Contract Management Area Operations in Philadelphia.

Freezing jet fighters

The Arms Production Dilemma: Contraction and Restraint in the World Combat Aircraft Industry
Randall Forsberg, ed.
MIT Press, 1994
300 pages; $39.95

MARK S. STERNMAN

Having helped turn back the nuclear buildup through the nuclear-weapons freeze in the 1980s, Randall Forsberg, executive director of the Institute for Defense and Disarmament Studies (IDDS), seeks a slowdown in the international trade in combat aircraft. The brunt of *The Arms Production Dilemma* explores aircraft production in Russia, the United States, Britain, Italy, Germany, France, and Sweden. Seventeen scholars scrutinize the relevant strategies and statistics of their own nations. Thirty tables, many drawn from the *IDDS Almanac 1994*, provide ample documentation.

The book opens with a provocative introduction by Forsberg, who points out two often-ignored aspects of arms sales: that they harm rather than enhance the seller's security; and, in doing so, they perpetuate the need for further damaging sales. In Iraq, Somalia, and Panama, U.S. soldiers faced U.S. weapons and military technologies in the arsenals of their adversaries. Forsberg asserts that weapons-producing nations could avoid repeating these mistakes by simply cooling off production and not selling arms to seemingly friendly nations that could become enemies.

Military planners, however, fear that shutting down production lines might leave nations vulnerable to unanticipated conflicts and sudden technological advances. Forsberg tries to avoid this familiar dilemma by suggesting that those who close down military facilities "could store information concerning production specifications and techniques in computer databases and on videotapes, earmark converted plants for potential future use, and establish an industrial reserve corps to maintain specialized skills."

The creativity of these ideas would give little comfort to the career bureaucrat who would have to implement them. Forsberg's focus is on combat aircraft, not economic conversion, but these broad thoughts hardly constitute a convincing argument for something as politically unpalatable as freezing production lines.

Another section provides unique insight into the thinking of the Russian military. Unfortunately but understandably, the analysts who wrote the chapter on Russian air strategy and production chose to remain anonymous. The rapid changes within the Russian military and the country itself make it impossible to ascertain this commentary's reliability. Nevertheless, the depth of information about the Russian air force and its tactics will no doubt appeal to specialists and planners who feel that Russia is still a potential threat to international stability.

In spite of the many differences among the seven major aircraft-producing nations, several common motifs are apparent. These patterns lend credence to Forsberg's optimism for the worldwide control of combat aircraft; on the other hand, these similarities no doubt derive from the common hunger to sell as many weapons as swiftly as possible.

For example, Sergei Kortunov of the Russian Foreign Ministry writes, "Russia's advantages . . . are the advanced technology of its aircraft, its low prices, the possibility of barter deals, and the possibility that it will transfer arms to areas that are 'sensitive' to the West—countries such as China, Iran, and possibly India." A forthright U.S. official could easily have made a mirror-image statement about the United States regarding U.S. offset packages and sales to Taiwan, Saudi Arabia, and possibly Pakistan. Sadly, the sell-first, worry-later mode of arms deals is universal, making the ideas advanced in *The Arms Production Dilemma* all the more vital—but, perhaps, impractical.

While impressive in breadth, the book at times portrays the world it wishes for rather than the world that is. Of course, as Kortunov claims, "Russia should also adopt a reasonable attitude toward the arms trade," but what evidence is there to indicate that this might happen?

In one chapter, three British researchers argue that diplomatic initiatives will likely limit arms sales to dictators—a claim disappointingly at odds with the attitudes of most American analysts, as well as the several British analysts with whom I met in 1994. Doubtless, the combat aircraft market will shrink; IDDS guesses that worldwide exports will decline by more than half during this decade. But with this shrinkage already taking place, government leaders may not be politically inclined to take the blame for closing off the market entirely. Ideally, analysts must do more than demonstrate why something should happen; they must also show what practical political motivations might effect the change.

The nuclear freeze succeeded because it sparked a broad-based grassroots movement and addressed the security concerns of the major powers. But the talks on limiting conventional arms after the Persian Gulf War faded when the short-term political need to sustain jobs through arms sales appeared more compelling than the deadly effect these arms sales had in the war. Today, there seems to be no support for limiting combat aircraft exports.

In the current U.S. political environment, where political parties try to outdo one another in their hawkishness and the fate of a treaty as sensible as the Chemical Weapons Convention remains uncertain, the ideas of Forsberg and her colleagues appear impractical. But *The Arms Production Dilemma* is just the beginning of a multi-year project known as the International Fighter Study (IFS), which may in the future find a more receptive political climate. ■

Mark S. Sternman is development director for National Security News Service in Washington, D.C.

(cont. from page 3)
right direction by removing a U.S. proposal that would have allowed states to step out of the treaty after ten years to conduct additional tests. With continued leadership from the United States and Russia, a five-power agreement that a CTB would prohibit *all* future nuclear explosions might be possible by the time the NPT extension conference concludes in mid-May.

More good news for the NPT would result if negotiations on a treaty ending the production of fissile material could begin soon. With agreement on a negotiating mandate in sight, these talks could be launched in the Conference on Disarmament in Geneva some time this spring.

Agreement among the five not to use nuclear weapons against states abjuring them would be hailed as an important additional step, satisfying a key demand of leading non-aligned states such as Nigeria and Egypt.

Above all, stronger efforts to assure prompt ratification of START II by the U.S. Senate and the Russian Duma is also urgently needed to secure wide support for the NPT's indefinite renewal. To that end, we urge stronger efforts in both countries, including discussions between key members of the Senate and the Duma on the significance of the treaty and the opportunity it affords for further steps toward nuclear disarmament. Sustained leadership by Presidents Clinton and Yeltsin could help to bring these arms control steps about.

There is little blocking progress on these issues other than politics. In the United States, a recent poll sponsored by the W. Alton Jones Foundation indicates that more than 80 percent of the American people support much more ambitious nuclear arms control measures than those so far pursued by the Clinton administration. A similar poll in Russia would likely produce similar results, particularly after the domestic criticism of the war in Chechnya.

By moving forward now to further de-emphasize and downsize our nuclear arsenals, the United States and Russia could not only help to make a permanent extension of the NPT possible, they could also strengthen the only global instrument that registers the international community's determination to reduce and ultimately eliminate the risks that nuclear weapons pose to all nations.

George Bunn
Center for International Security and Arms Control
Stanford, California

Roland M. Timerbaev
Monterey Institute of International Studies
Monterey, California

Indefinite extension, no

In the agreement known as the Washington Declaration of November 15, 1945, issued three months after the atomic bombing of Hiroshima and Nagasaki, the president of the United States and the prime ministers of Britain and Canada stated:

"We recognize that the application of recent scientific discoveries to the methods and practice of war has placed at the disposal of mankind means of destruction hitherto unknown, against which there can be no adequate military defense and in the employment of which no single nation can, in fact, have a monopoly."

Those leaders foresaw that a nuclear monopoly would lead to a dangerous imbalance in international relations between nuclear-weapons haves and have-nots.

British philosopher Bertrand Russell and Japanese physicist Hideki Yukawa asserted that nuclear weapons, as potential destroyers of humankind, are an absolute evil. No stretch of moral relativism can justify keeping these weapons of mass destruction, even for the purpose of nuclear deterrence.

The Nuclear Non-Proliferation Treaty (NPT), however, has legitimized a monopoly of nuclear arms by those states that acquired them before the NPT went into force on March 5, 1970. The NPT is further flawed because it promotes two fundamentally contradictory policies: first, to suppress the spread of nuclear weapons to other, non-nuclear weapon states; and, second, to promote the development of nuclear power plants worldwide. By promoting nuclear energy, the NPT disseminates the technical know-how for nuclear fission and encourages the accumulation of plutonium, a key weapons ingredient, as a byproduct.

Today, advocates of an indefinite extension of the NPT raise fears that, without the guiding hand of the great powers, the post–Cold War world could collapse into a state of anarchy out of which irresponsible outlaw states might emerge. But the authority of the NPT regime, which consists exclusively of five permanent members of the U.N. Security Council, is based on the outcome of a war fought a half-century ago. This anachronism is reminiscent of the silliness of the Holy Alliance of European monarchies in the nineteenth century.

The NPT extension conference now under way in New York will debate whether the treaty shall continue in force indefinitely or will be extended for an additional fixed period.

In my opinion, the NPT should not be indefinitely extended. A series of fixed periods would force the nuclear weapon states to make specific pledges toward nuclear arms reduction and eventual elimination. An urgent issue for the review conference is to determine the specific duration of each fixed period.

The unprecedented development of science and technology has radically changed the nature of warfare and challenges the traditional assumption that military force is the ultimate means of resolving political conflicts.

Even before the first nuclear test explosion on July 16, 1945, at Alamogordo, New Mexico, nuclear physicists around the world—and I was among that generation of scientists—knew quite well the disastrous effects that nuclear weapons promised. Over the coming months, we must not remain silent.

Toshiyuki Toyoda
Bulletin Sponsor
Tokyo, Japan

The Cold War—made in U.S.A.

I was so startled by a line in Mike Moore's November/December Editor's Note ("And it fully disabuses one of any lingering notion, promoted

by some historians, that the Cold War was largely the invention of Winston Churchill and Harry S. Truman. The Iron Curtain was real, and it was emplaced just where Old Joe wanted it"), that I followed his suggestion and read David Holloway's *Stalin and the Bomb* as well as Melvyn Leffler's *A Preponderance of Power*. I also read a recent biography of Allen Dulles, *Gentleman Spy*, by P. Grose; A.J.P. Taylor's *History of England 1914–45*; *Churchill*, by his doctor, Lord Moran; and Churchill's *Triumph and Tragedy*.

I still have no doubt that Moore's note is exactly backwards. The Dulles brothers—Allen and John Foster—openly advocated war against the Soviets. Nor can I forget my own experiences with the hostility showed by Western governments toward peace movements or efforts to have non-ideological contacts with fellow scientists.

Churchill often faced both ways—and he was a great re-writer of history, especially of Balkan policy. He agreed with Stalin on the spheres of influence in the Balkans and sought other opportunities for compromise and agreement, which were frustrated by the United States. The most charitable explanation for his "Iron Curtain" speech in Fulton, Missouri, is that he feared the United States might relapse into isolationism, leaving Europe in great economic difficulty.

But the main blame for the Cold War must rest on the United States, especially on Truman and the Dulles brothers for breaches of the Tehran, Yalta, and Potsdam agreements, and for insisting on measures that forced the division of Germany.

James H. Bradley
Wallingford, Pennsylvania

In England, they're dumps

A letter in the January/February *Bulletin* claims that to use the word "dump" for disposal of low-level nuclear waste is inaccurate, and that all waste is "carefully guarded, and all plans to date are to place it in safe repositories, not in dumps."

That may be so in the United States, but in Britain the situation is somewhat different.

According to the Department of the Environment, permits "may be issued by Her Majesty's Inspectorate of Pollution for the burial of some low-level radioactive waste at local authority or privately operated landfill sites, provided they have good containment characteristics."

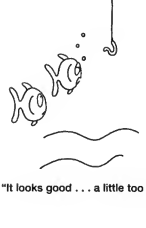
Problems resulting from limited dumping of radioactive waste on landfill sites include a twenty-fold increase in local tritium contamination in the Bristol area in 1992–93. Many other incidences of contamination may be unrecorded, since the inspectors take leachate samples only once a year and local authorities may not be told the results.

At present there are 39 local-authority-controlled waste sites licensed to take low-level waste in England, but if proposed legislation goes through Parliament, dumping will be extended to any waste site with "suitable clay geology."

There are also proposals to "enable Central Government to direct Local Authority waste disposal companies and private landfill operators to accept appropriate low level radioactive waste on refuse tips and private landfill sites." This legislation is apparently necessary because the government fears that radioactive waste may be refused as a result of "vocal opposition from local pressure groups."

This situation is one more example of the British government's sloppy management of nuclear matters which the Campaign for Nuclear Disarmament is working to expose and rectify—from massive overspending on the Trident program to nuclear convoy accidents on Britain's roads; from hypocrisy on nuclear disarmament as obligated by the Nuclear Non-Proliferation Treaty, to ignoring international concerns over the proliferation implications of the THORP reprocessing plant.

Janet Bloomfield
London, England



RAY PATHICO

"It looks good . . . a little too good."

Two views

In "Siemens Steps Into the Breach," (January/February *Bulletin*), Mark Hibbs quotes a "representative of the Frankfurt Peace Research Institute [FPRI]" as saying, "Germany is now a fully sovereign country. Why shouldn't we get the Russian plutonium to make MOX [mixed oxide] fuel in Germany?" But no representative of the FPRI would link the fact of German sovereignty to the idea of using German MOX technology to dispose of weapons plutonium.

Hibbs apparently mixed two separate remarks I made some months ago. On one occasion, I explained to him that Germany renounced weapons of mass destruction as part of the 2+4 treaty, which recognizes German sovereignty. Because that treaty is of indefinite duration, he should not worry about future German nuclear weapons.

On another occasion I said that the idea of using existing MOX technology to dispose of weapons plutonium is at least worth a careful examination. It might even bring an end to further reprocessing of civilian plutonium.

Annette Schaper
Frankfurt, Germany

Mark Hibbs responds: There was no mixup. At issue is a single conversation I had with Annette Schaper in Minsk on October 6, 1994, not as Schaper claims, two separate discussions. On October 6, Schaper's defense of the Russian-plutonium-to-Germany gambit was based on a reunified Germany's sovereign right under the Euratom Treaty to dispose of plutonium, not on any German commitment to forgo nuclear weapons. The only reference to "future German nuclear weapons" is in her letter to the *Bulletin*. The subject did not arise in our conversation, nor in my article.

KNOWN NUCLEAR TESTS WORLDWIDE, 1945–1994

China was the only nation that tested nuclear devices during 1994. China conducted its first test on June 10, and another on October 7. The United States last tested on September 23, 1992; the Soviet Union on October 24, 1990; Britain on November 26, 1991; and France on July 15, 1991. During the 34-month November 1958–September 1961 moratorium, the United States, Britain, and the Soviet Union did not test, but the French conducted their first four tests during this period. As of April 1, 1995, the current moratorium has lasted 30 months (except for four Chinese tests).

Since last year's update (May/June 1994 *Bulletin*), the release of more information about the nuclear testing programs of the United States and Russia continues to re-categorize and refine the global testing record. On December 7, 1993, U.S. Energy Secretary Hazel O'Leary divulged that there had been 204 "secret" (unannounced) tests from 1963 to 1990. On June 27, 1994, O'Leary released further information, adding three more to the list and bringing the total number of tests to 1,054. (The two combat uses at Hiroshima and Nagasaki are not included, but 24 joint tests with Britain are.)

The reason for the additions had to do with the definition of a nuclear "test." The United States defines a test—for purposes of the above count—as either a single explosion, or two or more explosions fired within 0.1 second of each other within a circular area 2 kilometers in diameter. On further analysis of the record, the Energy Department found that three explosions had been detonated more than 0.1 second apart from a nearly simultaneous explosion, and therefore should be counted as separate tests.

More light was shed on the practice of simultaneous explosions as well. Sixty-three tests involved more than one explosive device, and were fired within 0.1 second or less of each other. These 63 tests involved 158 detonations resulting in 95 additional explosions that are not counted as tests. One test used six nuclear explosive devices, two used five, four used four, 14 used three, and 42 used two devices.

Those conducted in a single vertical shaft are sometimes referred to as the "string of pearls." In other tests there were two or more drilled shafts separated by a considerable distance with one device in each hole. The new official total of 1,054 "tests" thus involved the detonation of 1,149 discrete nuclear explosive devices.

Another refinement of the data was a clarification of the number of safety experiments. For many years the number had been listed as 34. After review, 54 tests that had previously been described as weapons-related were added to the safety category, bringing the new total to 88.

An additional number of hydronu-

Test locations

The five declared nuclear powers have acknowledged conducting a total of 2,036 nuclear tests since 1945: 942 of these have taken place within the continental United States, making it by far the most common testing location. The tests in Kazakhstan include those at the Semipalatinsk test site and 26 Peaceful Nuclear Explosions (PNEs). The tests in Russia include 132 at Novaya Zemlya, 81 PNEs, and one at Totsk. Islands and atolls in the Pacific were the location of 306 tests conducted by the United States, Britain, and France.

Nevada	935	Pacific Ocean	4
Kazakhstan	496	Malden Island	3
Russia	214	South Atlantic Ocean	3
Mururoa Atoll	175*	Alaska	3
Enewetak	43	New Mexico	3
China (Lop Nur)	41	Mississippi	2
Christmas Island	30	Colorado	2
Bikini	23	Ukraine	2
Algeria	17	Uzbekistan	2
Johnston Island	12	Turkmenistan	1
Australia	12	India	1
Fangataufa Atoll	12		

*Assumes the 12 French safety tests were conducted at Mururoa.

A tunnel at the Nevada Test Site used to assemble equipment for underground tests.

LAWRENCE LIVERMORE NATIONAL LABORATORY

clear tests were conducted during the 1958–1961 testing moratorium. Los Alamos acknowledges that they conducted 35 such tests at Los Alamos beginning in January 1960. Livermore conducted a smaller number of hydronuclear tests (we estimate about 15) at the Nevada Test Site.

This data is more than merely a historical curiosity. The question of safety experiments and hydronuclear tests are a contentious issue at the comprehensive test ban negotiations in Geneva. Some would prefer a ban on all types of nuclear experimental activity, while others want some kinds to be permitted—and they differ as to what size yield to allow.

The U.S. position is to limit the experiments to four pounds of nuclear yield. Britain—for reasons not altogether clear—favors 100 pounds. The Russians want to test at yields of at least 10 tons, the French to levels of 100–200 tons, and the Chinese reportedly up to 1 kiloton. There is general consensus among scientists that tests with yields of a few tons or more would be of substantial value to proliferators, and would begin to be of value to nuclear weapon states in developing new weapons.

Russia has yet to publish a definitive list of all of its tests, but some new information has been supplied to the authors about aspects of their test program. According to this private information, the Soviet Union/Russia has conducted approximately 1,100 discrete device detonations.

Of these, nearly 1,000 produced yields greater than one ton. In line with the threshold definition used by the United States, Russia counts these 1,000 as 718 "tests." Most of the other 100 or so—those below one ton—were hydronuclear experiments with yields under 100 kilograms. Until we have a fuller accounting of these, and an agreed-upon definition of a test, the accompanying table remains incomplete. ■

Nuclear Notebook is prepared by Robert S. Norris and William M. Arkin of the Natural Resources Defense Council. Inquiries should be directed to NRDC, 1350 New York Avenue, N.W., Suite 300, Washington, D.C. 20005 (202-783-7800).

	U.S.		S.U.		Britain		France		China		
Year	A	U	A	U	A	U	A	U	A	U	Total
1945	1	0	0	0	0	0	0	0	0	0	1
1946	2	0	0	0	0	0	0	0	0	0	2
1947	0	0	0	0	0	0	0	0	0	0	0
1948	3	0	0	0	0	0	0	0	0	0	3
1949	0	0	1	0	0	0	0	0	0	0	1
1950	0	0	0	0	0	0	0	0	0	0	0
1951	15	1	2	0	0	0	0	0	0	0	18
1952	10	0	0	0	1	0	0	0	0	0	11
1953	11	0	5	0	2	0	0	0	0	0	18
1954	6	0	9	0	0	0	0	0	0	0	15
1955	17	1	6	0	0	0	0	0	0	0	24
1956	18	0	8	0	6	0	0	0	0	0	32
1957	27	5	18	0	7	0	0	0	0	0	57
1958	62	15	35	0	5	0	0	0	0	0	117
1959	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	3	0	0	0	3
1961	0	9/1*	52	1	0	0	1	1	0	0	65
1962	39	55/2	71	1	0	2*	0	1	0	0	171
1963	4	41/2	0	0	0	0	0	3	0	0	50
1964	0	39/6	0	10	0	2	0	3	1	0	61
1965	0	37/1	0	10/4**	0	1	0	4	1	0	58
1966	0	44/4	0	16/2	0	0	5	0	3	0	75
1967	0	39/3	0	16/1	0	0	3	0	2	0	64
1968	0	52/4	0	14/4	0	0	5	0	1	0	80
1969	0	45/1	0	14/4	0	0	0	0	1	1	66
1970	0	38/1	0	11/3	0	0	8	0	1	0	62
1971	0	23/1	0	16/7	0	0	5	0	1	0	53
1972	0	27	0	17/8	0	0	3	0	2	0	57
1973	0	23/1	0	12/5	0	0	5	0	1	0	47
1974	0	22	0	17/4	0	1	7	0	1	0	53†
1975	0	22	0	17/2	0	0	0	2	0	1	44
1976	0	20	0	18/3	0	1	0	4	3	1	50
1977	0	20	0	18/5	0	0	0	8	1	0	52
1978	0	19	0	22/7	0	2	0	8	2	1	61
1979	0	15	0	24/8	0	1	0	9	1	0	58
1980	0	14	0	20/5	0	3	0	13	1	0	56
1981	0	16	0	16/5	0	1	0	12	0	0	50
1982	0	18	0	12/9	0	1	0	9	0	1	50
1983	0	18	0	19/9	0	1	0	9	0	2	58
1984	0	18	0	18/11	0	2	0	8	0	2	59
1985	0	17	0	10/2	0	1	0	8	0	0	38
1986	0	14	0	0	0	1	0	8	0	0	23
1987	0	14	0	20/6	0	1	0	8	0	1	50
1988	0	15	0	14/2	0	0	0	8	0	1	40
1989	0	11	0	8	0	1	0	8	0	0	28
1990	0	8	0	1	0	1	0	6	0	2	18
1991	0	7	0	0	0	1	0	6	0	0	14
1992	0	6	0	0	0	0	0	0	0	2	8
1993	0	0	0	0	0	0	0	0	0	1	1
1994	0	0	0	0	0	0	0	0	0	2	2
Total	215	815	207	508	21	24	45	147***	23	18	2,036†

A=atmospheric; U=underground. *All British underground tests were conducted in the United States. **Numbers after the "/" represent Soviet or U.S. peaceful nuclear explosions. ***12 French safety tests not identified by date are not included here; however, they have been added to the grand total. †Includes one underground explosion by India on May 17, 1974.

A fine garble

Powell & Company got it wrong; does anyone care?

By WILLIAM M. ARKIN

The Pentagon seems bewitched, bothered, and bewildered, not to mention befuddled, regarding the circumstances under which it might be appropriate to use nuclear weapons in battle.

On April 29, 1993, Gen. Colin Powell, then chairman of the Joint Chiefs of Staff, approved a new "Doctrine for Joint Nuclear Operations" (Joint Publication 3-12). Alas, the doctrine not only failed to accurately represent official U.S. policy, it flatly contradicted it. The doctrine declared that "the fundamental purpose of U.S. nuclear forces is to deter the use of weapons of mass destruction. . . ." Further, it defined weapons of mass destruction as "nuclear, biological, or chemical."

The new doctrine is at odds with a 16-year-old pledge by the United States—first articulated at the United Nations in 1978—not to threaten to use nuclear weapons against any nation unless that nation is a nuclear power itself, or unless it attacks the United States or its allies in an alliance with a nuclear-weapon state.

This straightforward policy was reiterated during the Reagan and Bush administrations, and it is central to the current administration's campaign to seek unconditional and indefinite extension of the Nuclear Non-proliferation Treaty (NPT). Finally, the pledge is contained in the recent formal "security assurances" exchanged between the United States, Britain, Russia, Ukraine, Kazakhstan, and Belarus upon the accession of the latter three to the NPT.

So how is it that a publication under the aegis of Colin Powell can be so far off the mark? The answer, as several officers have painstakingly tried to explain to me, is that the uniformed military doesn't have the authority to make policy. Well, sure, we already know that. In the United States, defense policy is made by civilians.

But how, I ask, can a new doctrine coexist with a declared U.S. policy that says just the opposite? A contradictory doctrine cannot exist, I'm told. But it does. It's on my desk right now. And that's a rotten shame. After all, someone out there in our far-flung nuclear infrastructure might actually believe that Joint Pub 3-12 is rooted in fact rather than fantasy.

"People in the field do take these new doctrinal publications seriously," an analyst at the Institute for National Strategy Studies at the National Defense University told me. But will the new doctrine lead to new nuclear planning to target non-nuclear nations and prepare new war plans, I ask. "I suppose," says the analyst. "But what's wrong with planning?"

"Doctrine" might be described as the military's preferred way of doing things, but it is well understood that it must be in accord with national policy. So where did the authors of Joint Pub 3-12 get the impression that the *fundamental purpose* of U.S. nuclear weapons was to deter anything other than nuclear weapons? The answer lies in the document's origins—the U.S. Strategic Command, or STRATCOM.

STRATCOM drafted the doctrine, and it is not far-fetched to believe that it was ginned up to enhance STRATCOM's parochial mission. But how did such a statement get past political review? Apparently, the five layers of political appointees inside the Pentagon that looked at it were unbothered by the expansion of nuclear missions.

Former Defense Secretary Les Aspin's first (and only) "Report to Congress" in February 1994 stated that "the role of U.S. nuclear forces in deterring or responding to . . . non-nuclear threats must be considered." That sentence provoked a lot of disagreement inside the government and even inside the Pentagon, because it followed the report of the controversial "Reed-Wheeler" panel, sponsored by the Strategic Air Command, STRATCOM's predecessor.

The Reed-Wheeler folks suggested a broad range of faddish new missions for nuclear weapons. Former Air Force Secretary Thomas Reed and retired Col. Michael Wheeler testified before Congress in January 1992 that they were uncomfortable with any policy "that suggested that a nation can engage in any level of chemical or biological aggression and still be shielded by an American non-nuclear pledge." STRATCOM agreed, and they and the nukies on the Joint Staff worked feverishly since then to expand nuclear targeting.

Being curious about the impact of the new doctrine, I sent off a series of Freedom of Information Act requests for documents focusing on the implementation of the doctrine. The responses have been uniformly befuddled. STRATCOM said in February that it has seen no need to further implement 3-12. "Its existence is adequate promulgation," the command wrote. That is: We wrote it; we don't need to respond to it; it reflects what we already do.

And how are the regional commands coping with the new focus on weapons of mass destruction? Central Command, which is responsible for the Middle East—including Iran—initially responded that it was "unable to locate any information in the Command pertaining to joint nuclear doctrine." Upon prodding, Central Command stated that in the January 1995 review cycle, it did offer input about Joint Pub 3-12. But the input consisted of "administrative comments only (spelling and punctuation)."

The spelling is good. Meanwhile, one wonders: Have STRATCOM and the Joint Staff intentionally usurped political authority, or have the politicos so dithered and waffled that the military has just gone ahead and "done its job"? ■

William M. Arkin is an independent expert on defense matters and a Bulletin *contributing editor.*

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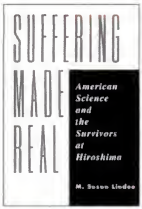

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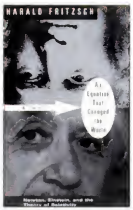

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